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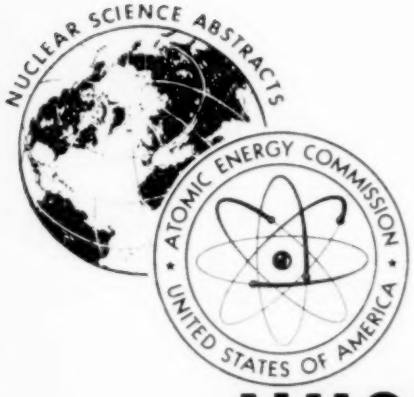

NUCLEAR SCIENCE ABSTRACTS

Volume 17 Number 14
Abstracts 22965 – 24738

July 31, 1963

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Volume 17, Number 14, July 31, 1963

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, May 20, 1963.

Volume 17, Number 14 July 31, 1963

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

22965 (AERE-Bib-127(Suppl.2)) LIST OF UNCLASSIFIED REPORTS AND PAPERS PUBLISHED BY STAFF OF THE ISOTOPE RESEARCH DIVISION FROM SEPTEMBER 1961 TO DECEMBER 1961. R. J. Millett and R. Sweeney, comps. (United Kingdom Atomic Energy Authority. Research Group. Wantage Radiation Lab., Harwell, Berks, England). Feb. 1963. 14p.

A bibliography of all unclassified reports and papers published by the AERE Isotope Research Division from Sept. 1961 to Dec. 1962 is presented. (J.R.D.)

22966 (BMI-1614(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY 1963. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Feb. 1, 1963. Contract W-7405-eng-92. 82p.

Research and development progress is reported on reactor materials and components, fuels, PuN and its alloys, fuel elements, radioisotope and radiation applications, a tracer system for in-place filter evaluation, materials evaluation, coated-particle fuel materials, corrosion studies of the fluoride-volatility process, creep-rupture of SAP alloys, fission-product deposition, irradiation of materials and components, gas-cooled reactor program, properties of F-48 niobium alloy, and joining of regenerative cell components. (M.C.G.)

22967 (IDO-16857) MATERIALS TESTING REACTOR–ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT, OCTOBER 1–DECEMBER 31, 1962. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 29, 1963. Contract AT(10-1)-205. 69p.

Initial criticality of ARMF II was achieved December 4, 1962, on 3201 g U^{235} with a center-hole equivalent of one fuel element. The instrumentation included an automatic data integrator and readout system. Heat transfer conditions in a simulated ETR flow channel were measured up to burnout (3.8×10^6 Btu/hr ft^2). This work substantiated the use of the Ditus-Boelter and the Jens & Lottes correlations for heat transfer in ETR fuel elements. Preliminary results were obtained in irradiation testing of sample fuel plates containing powdered uranium-aluminum intermetallic compounds. A study was made of the desirability, from a nuclear standpoint, of replacing the present cadmium safety rods in the ETR by hafnium rods. Hafnium was found to be superior to cadmium both in total shutdown worth and resistance to burnout. A series of calculations was made to study the epithermal poison sensitivity in the ARMF for modified experimental water hole conditions. It was found that the sensitivity was increased significantly by reducing the water hole from a 6.5- to a 3.25-in. square and placing a Mark II fuel element in this position with the sample located at the center of this assembly. Collaborative nuclear chemistry and fast chopper measurements of a 360-curie sample of Ta^{182} (115 day) reveal a prominent resonance at 0.147 ev with a peak cross section of 47,000 barns. Reasonable account of some aspects of the inelastic scattering of thermal energy region neutrons from liquid methane can be made using a cluster model involving 18 molecules. Rotational freedom is allowed but the translational motion is inhibited. Measurements of neutron inelastic scattering from powdered Be reveal strong structure effects. A detailed study of the shapes of gamma ray spectra obtained with NaI scintillation counters was completed. The problems associated with the development of computer techniques for analysis of pulse-height spectra are treated. Procedures for handling these data with computer programs are presented. Installation and check-out of the instrumentation and control system for the ARMF II was completed. Some of the important features of the regulating rod readout and shim rod drive readout are described. The results of tests of pressure transducers and associated cables in a high peak flux environment is reported along with laboratory tests of strain gages. An experimental displacement flowmeter was developed to measure the transient flow of the water moderator during transient power excursions of a reactor. A three-phase frequency divider was developed for use with the velocity selector. Other experimental techniques include a logarithmic X-Y plotter, a new method of measuring magnet release time, and a time-saving chart reader. The library of nuclear codes on tape at the Bartlesville computing center now encompasses 26 separate programs ready for routine use. In addition the gamma shape generation was largely converted to FORTRAN, along with other programs for the analysis of gamma spectra. A program to solve numerically an integral equation of the first kind was written and checked out for the IBM 650. (auth)

22968 (JAERI-7026) JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. A BRIEF GUIDE. (Japan Atomic Energy Research Inst., Tokyo). Apr. 1963. 32p.

Activities of the Japan Atomic Energy Research Institute are reported. Topics covered include: research and development, research facilities, service facilities, other institute activities, schools, Takasaki Research Establishment, and general affairs. (M.C.G.)

22969 (TID-7656) CURRENT TRENDS IN NUCLEAR POWER. Symposium Held at University of Arizona, Tucson, February 26–March 12, 1962. Earl W. Phelan, ed.

(Argonne National Lab., Ill.). Contract [W-31-109-eng-38]. 130p.

Topics discussed include: Yankee Atomic Power Reactor, engineering education and design; research, fluidized, and fast reactors; fuel reprocessing; plutonium and uranium ceramic fuels; the Dresden Station in-core monitor system; compact reactor systems; nuclear fusion; plutonium technology; waste disposal, reactor safety; nuclear power plants; and nuclear space propulsion. (P.C.H.)

22970 TWILIGHT LITHIUM IN THE UPPER ATMOSPHERE. HIGH ABUNDANCE OF TWILIGHT LITHIUM, NOVEMBER 1962. W. A. Gault and D. M. Hunten (Univ. of Saskatchewan, Saskatoon). Nature, 198: 469(May 4, 1963).

A large enhancement in upper-atmosphere Li abundance observed at twilight with a birefringent photometer at Saskatoon, Canada (52°N) during November 1962 closely resembled conditions observed during August 1958. It is concluded that both events were caused by intermediate-yield thermonuclear explosions at a height near 60 km. (C.H.)

22971 ADVANCES IN THE ASTRONAUTICAL SCIENCES. VOLUME 8. PROCEEDINGS OF THE SEVENTH ANNUAL MEETING OF THE AMERICAN ASTRONAUTICAL SOCIETY, DALLAS, TEXAS, JANUARY 16-18, 1961. New York, Plenum Press, 1963. 601p. $19.50.

Lectures are presented that include the topics of space communications, solar system physics, bioastronautics, re-entry and recovery, geophysical exploration, astrodynamics, space systems applications, navigation and guidance, cosmology, lunar exploration, and the social and political aspects of space activities. Abstracts are prepared for four of the fifty-eight papers presented. The paper "Protection Against Solar Flare Protons" was previously abstracted in NSA (15: 31461). (C.E.S.)

22972 ADVANCED PROPULSION SYSTEMS. Harold B. Finger (National Aeronautics and Space Administration, Washington, D. C.). p.9-14 of "Advances in the Astronautical Sciences. Vol. 8." New York, Plenum Press, 1963.

A brief insight into advanced propulsion concepts that will provide capability to travel in space at will is presented. Nuclear rocket propulsion, electrical propulsion systems, and plasma jets are discussed. A number of advanced propulsion schemes that are still in the idea stage are considered and evaluated. (C.E.S.)

22973 WAVE PROPAGATION THROUGH A HOT PLASMA. F. J. Tischer (Ohio State Univ., Columbus). p.37-46 of "Advances in the Astronautical Sciences. Vol. 8." New York, Plenum Press, 1963.

The theory of wave propagation through ionized gas attracts increased attention as a tool for the study and description of phenomena observed in satellite and rocket experiments. Diagrams, necessary for the interpretation of the results because of their mathematical complexity, are presented. In contrast to the familiar charts for a cold plasma, these diagrams take into account collisions between particles and are thus also valid for high-temperature plasma. The diagrams show the complex permittivity of the plasma, the wave propagation constant inside the medium, and the reflection coefficient at the boundary of a layer. Variables and parameters are the particle density, number of collisions, the magnetic field intensity, and the operational frequency. The diagrams show the influence of these parameters, permit interpretation of observed phenomena, and indicate the way to improve the wave propagation artificially. (auth)

22974 GEOMAGNETIC ACTIVITY AND MAJOR SOLAR FLARES. Barbara Bell (Harvard Coll. Observatory, Cambridge, Mass.). p.92-102 of "Advances in the Astronautical Sciences. Vol. 8." New York, Plenum Press, 1963.

A statistical study of relations between geomagnetic activity and major solar flares is summarized. Primary attention was given to the magnetic type of the sunspot producing the flare. The data cover the years 1937 to 1959 and include 580 major flares. It is found that a major flare occurring in association with a sunspot group of complex magnetic polarities is much more likely to be followed by a major geomagnetic storm than is a similar flare associated with a simple unipolar or bipolar spot group. The effect of location of the flare on the solar disc was also studied. Flares followed by great storms show the expected concentration toward the central regions of the solar disc and also an unexpected concentration in the northern solar hemisphere. In the 23 years studied, it was found that northern spot groups produced 62% of all observed major flares and 86% of those that were followed within 3 days by a great geomagnetic storm. This concentration of great-storm flares in the solar north occurs about equally in each of the three sunspot cycles studied and appears unrelated to the 11 or 22-year solar activity cycle. (auth)

22975 COSMOLOGY AND THE STRUCTURE OF ELEMENTARY PARTICLES. Lloyd Motz (Columbia Univ., New York). p.476-87 of "Advances in the Astronautical Sciences. Vol. 8." New York, Plenum Press, 1963.

The Weyl theory of gauge invariance leads to an operator that is, except for its constant term, identical with the second-order Dirac operator. If one equates the two constants of these operators, one is led to a value of the gravitational constant inside a fundamental particle equal to $\hbar c/m^2$. This has important consequences for cosmology since one can derive from it a relationship involving the radius of an Einstein universe, the speed of light, and the mass of the universe. Some of the features of an expanded universe arising from a highly condensed state are investigated in line with the ideas developed. (auth)

BIOLOGY AND MEDICINE

General and Miscellaneous

22976 (AD-286799) LESIONS IN THE ORAL TISSUES INDUCED BY EXPOSURE TO MULTIPLE SUBLETHAL DOSES OF TOTAL BODY X-IRRADIATION IN THE MOUSE AND THE EFFECTS OF DIETARY SUPPLEMENTS OF BIOFLAVONOIDS THEREON. Final Technical Report, November 1, 1961–October 31, 1962. Benjamin H. Ershoff (Western Biological Labs., Culver City, Calif.). Contract DA-49-193-MD-2210. 8p.

The effects of multiple sublethal doses of total-body x irradiation were determined on the oral tissues of mice fed a highly purified basal ration and the basal ration plus supplements of bioflavonoids of diverse structure and physicochemical properties. Similar lesions were observed in all x-irradiated mice with no significant differences between the various dietary groups. The lesions observed include rarefaction, collagenolysis, pyknosis, canalization with capillaries, and inclusions of squamous epithelium and osteoclasts of the periodontium; focal resorption of the acellular cementum; osteoclastic inclusions in the dentin; acute gingivitis and interdental pyorrhea; decreased trabiculation and bone marrow of the alveolar bone; and neoplastic changes of the lacrimal gland, submaxillary salivary gland and squamous epithelium. Lesions comparable to the above were not observed in non-irradiated mice in the various dietary groups. (auth)

22977 (DASA-1325) THE OVERPRESSURE-DURATION RELATIONSHIP AND LETHALITY IN SMALL ANIMALS. Technical Progress Report. D. R. Richmond, V. C. Goldizen, V. R. Clare, and C. S. White (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Sept. 10, 1962. Contract DA-49-146-XZ-055. 56p.

A total of 993 mice, rats, guinea pigs, and rabbits were exposed to sharp-rising overpressures of various short durations. They were mounted on a concrete pad above which high-explosive charges, ranging in weight from 0.50 oz to 64 lbs, were detonated. Pressure-time measurements were obtained with pencil-type and shock-tube piezo-electric gauges on the pad directly beneath the charges. The duration of the blast waves ranged from 0.40 to 6.8 msec. The LD_{50} pressures were calculated for each species at the different pulse durations. In general, the pressures required to produce 50% lethality rose at the shorter durations. Combining the results of this study with those from previous shock-tube investigations made it possible to define the tolerance of four small-animal species to sharply rising overpressures as a function of pulse duration. (auth)

22978 (USNRDL-TR-629) CONSTRUCTION OF A MODIFIED HENDERSON APPARATUS. J. F. Pribnow and M. S. Silverman (Naval Radiological Defense Lab., San Francisco). Mar. 14, 1963. 13p. (AD-404011)

An apparatus for exposing mice to an aerosol of microorganisms was developed. It is a modification of the Henderson apparatus, adapted for exposure of smaller animals. The design allows for placement of the complete apparatus in a bacteriological hood. Although of relatively simple design and operation, it has proven highly dependable. (auth)

22979 EIGHTH INTERNATIONAL CANCER CONGRESS UNDER THE AUSPICES OF THE INTERNATIONAL UNION AGAINST CANCER, MOSCOW, 22nd to 28th JULY, 1962. Acta, Unio Intern. Contra Cancrum, 19: 1-427(1963).

Separate abstracts were prepared on 6 papers presented at this conference. Other papers cover various aspects of cancer induction and pathology. (C.H.)

22980 IMMUNOLOGICAL STUDIES WITH POLYOMA-INDUCED TUMORS IN HAMSTERS. V. Defendi (Wistar Inst., Philadelphia). Acta, Unio Intern. Contra Cancrum, 19: 115-19(1963). (In English)

An inadequate immunological response to tumor induction by polyoma virus (PV) was demonstrated in hamsters. The role of possible new antigens in this phenomenon was investigated. Neither involution by ligation of virus-free PV induced tumor, nor immunization attempts by isologous tumors yielded efficient protection against PV tumor induction. Immunization by irradiated H61-104 cells was of very short duration, as was an attempt to immunize mice with PV induced hamster tumor. Immunization by PV gave some protection against challenge by PV induced tumors, induced both in vivo and in vitro. Various hypotheses are discussed. Weakening with time of new antigens in PV induced tumors is considered the most plausible explanation. (auth)

22981 STUDIES ON INDUCED IMMUNITY AGAINST D'EHRLICH TUMORS. C. Mazurek and J.-F. Duplan (Université, Paris). Acta, Unio Intern. Contra Cancrum, 19: 124-7(1963). (In French)

Irradiated (12,000 r) Ehrlich tumor cells induced an immunity against living Ehrlich tumor cells in mice. Sublethal irradiation of mice (750 r) followed by cellular restoration inhibits the growth of Ehrlich tumors. The irradiation suppresses immunity previously acquired against Ehrlich cells. Results of immunization after irradiation depends on the length of interval and the nature of restoring cells. Fetal cells do not allow restoration of immunological potency. (auth)

22982 LOCALIZATION OF ANTIFIBRIN ANTIBODIES IN HUMAN TUMORS. W. C. Dewey (Univ. of Texas, Houston), W. F. Bale, R. G. Rose, and D. Marrack. Acta, Unio Intern. Contra Cancrum, 19: 185-96(1963). (In English)

The localization of an I-131-labeled rabbit antibody to human fibrinogen was studied in 36 patients with metastatic malignant disease. Selective concentration of I-131 antibody in all the known tumor sites was found in 11 out of 15 sarcoma patients, in all of the 4 melanoma patients, and in 8 out of 17 patients with a variety of other cancer types. In the 13 remaining patients localization was either poor or occurred in some of the tumor sites in a given individual but not in others. Therapy by the administration of I-131 as a label on antibody carrier was attempted in one patient with melanoma and in 4 patients with osteogenic sarcoma; some clinical evidence of remission was seen, but this was not sustained. Preliminary autoradiographic and histological studies of tissues obtained at autopsy from patients who received therapeutic doses of I-131 indicated that the selective localization of I-131 antibody in tumor was nonuniform and associated sometimes with viable tumor cells but more often with hemorrhage, degeneration, necrosis, and inflammation. Localization was also observed in agonal thrombi, in regions of inflammation not associated with tumor; in areas of calcification, and in apparently uninflamed normal fibrous tissue. (auth)

22983 PREPARATION OF PURIFIED I^{131} LABELED ANTISERA TO HUMAN FIBRINOGEN. PRELIMINARY STUDIES IN TUMOR PATIENTS. I. L. Spar, W. F. Bale, R. L. Goodland, and G. Di Chiro (Univ. of Kentucky, Lexington; Univ. of Rochester, N. Y.; National Inst. of Neurological Diseases and Blindness, Bethesda, Md.; and National Inst. of Health, Bethesda, Md.). Acta, Unio Intern. Contra Cancrum, 19: 197-200(1963). (In English)

Investigations showed that I^{131} rat fibrinogen or labeled and purified antibodies to rat fibrinogen localize very specifically in some transplantable rat tumors. Comparable preparations of antisera to dog fibrinogen will localize with considerable specificity in some spontaneous dog tumors and the results suggest that similar human preparations would have diagnostic and therapeutic usefulness in cancer patients. Rabbit antisera to human fibrinogen was purified, labeled with I^{131} and then repurified. Results of in vitro tests on such preparations showed that a major portion of the I^{131} label was attached to antibody that would react with human fibrinogen or fibrin. Such sterile solutions were injected into tumor patients and scintillation scanning indicates that preparations of this type may be useful for diagnosis and delineation of such lesions, and even for therapy of some of them. (auth)

22984 COMMENTS ON VIRAL NEOPLASIA. J. Furth (Columbia Univ., New York and Francis Delafield Hospital, New York). Acta, Unio Intern. Contra Cancrum, 19: 243-6 (1963). (In English)

Latent viruses with capacity to produce tumors seem to be ubiquitous in all animals and probably are also ubiquitous in man. Secondary factors are essential for the actuation of tumors by viruses as well as for the growth of many initiated or dependent tumor cells. The promoting factors include tropic hormones, the physiologic general and special growth stimuli of infancy and childhood, and the proliferative stimuli of injury. Thus, we conceive viruses as both initiators and promotors of tumors. Control measures are logically directed not only against the causative virus but towards modification of the host factors which are influential in growth of tumors. (auth)

22985 INVESTIGATIONS ON THE MODE OF ACTION OF LEUKEMOGENIC AGENT EXTRACTS IN RADIOLEUKEMIAS OF THE C57BL MOUSE. J. F. Duplan (Université, Paris). Acta, Unio Intern. Contra Cancrum, 19: 393-6 (1963). (In French)

The mechanism of leukemogenesis in x-irradiated C57BL mice was studied by combining the action of the leukemogenic virus to the effect of x radiation. By itself the extract induces 30 to 50% of leukemias when injected in newborn or in young adults. When young mice are injected three times before their exposures to x ray the number and the latency of lymphoid leukemia are similar to the control one. Hence it seems that this treatment can neither immunize the mice against the leukemogenic virus nor enhance the leukemogenic process. But it is possible that injecting the extract just after each of the exposures to x ray enhance the leukemogenic process. (auth)

22986 POSSIBILITIES FOR INCREASING PERCEPTION DETAIL IN X-RAY PICTURES. Wybe J. Oosterkamp (N. V. Philips Gloeilampenfabrieken, Eindhoven, Netherlands). Aerztl. Forsch., 16: 122-9(Mar. 10, 1962).

Technical improvements are described that allow more detailed medical roentgenograms at lower x-ray exposures to the patient. With the modifications described it is possible to almost double the specific load of rotating anode tubes by increasing the speed of rotation and/or the size of the anode disc. In this way the total blurring in recording moving objects is reduced by 20 to 30%. Through electronic methods of copying (such as Log-Etronics), picture contrasts can be increased to a large extent. This, however, has not led to significant improvement in recognition of detail. An x-ray image intensifier is now available for fields up to about 12 in. The inconveniences in their use for routine x-ray pictures can be diminished through new optical devices, particularly when the picture is observed with the aid of a closed TV circuit. Other new possibilities are discussed, such as the recording of x-ray pictures through magnetic devices, leading to a decrease in dosage and time for reading the results. The improvement of detail in medical radiographs by the use of monochromatic x rays is also considered and advantages of the technique are cited. (H.H.D.)

22987 PANORAMA TECHNIQUE—X-RAY PHOTOGRAPHIC PROCEDURE—PANORAMIX. W. Ott. Bull. Schweiz. Akad. Med. Wiss., 18: 329-39(Feb. 1963). (In German)

A new procedure for roentgen photography, which is based on the principle that roentgenographs of body cavities can be made more suitably by projecting the rays from a geometric point in the middle towards the outside of the arch, is described. For this, it is necessary to have a source of rays that gives a wider angle than usual. This is possible with a cone or pyramid anode. The procedure for use in dental radiology is as follows: a Panoramix tube is placed horizontally in the mouth of the patient so that the x-ray source lies approximately at the level of the distal limit of the six-yr molars. A flexible film is held externally around the upper and lower jaw. The patient holds this with his hands so that in the lower jaw the strip is pressed with the back, lower edge, and in the upper jaw with the upper edge, on the skin. The exposure is then made and the tube and film removed. If single roentgenographs of the under and upper jaw are to be made, it is recommended that the tube have a corresponding vertical slant. According to the type of film, and to whether a re-enforcing filter is used, the exposure times are from 0.1 to 0.7 sec at 55 kv and 0.5 ma. (TCO)

22988 LIQUID SCINTILLATION COUNTING WITH GLASS FIBER PAPER. Karoly G. Pinter, James G. Hamilton, and O. Neal Miller (Tulane Univ., New Orleans). Anal. Biochem., 5: 458-61(May 1963). (In English)

The efficiency of counting C^{14} on cellulose paper was compared with that of glass fiber paper. It was observed that cellulose paper is only about 60% as efficient as glass fiber paper. Identical amounts of fucose-1-C^{14} were placed on each type of paper and the disks were counted in a nonpolar scintillation fluid. The proportionality between radioactivity and number of disks added to the vial is equally good for both kinds of paper. Results indicated that radioactivity is linearly proportional to the number of disks (up to 25) added to the counting vial over a range of 100 to 40,000 cpm. This relationship seems to hold for both lipid-soluble and water-soluble compounds. The specific activity can be calculated by using the guide strip for determination of the amount of cholesterol and cholesterol esters; and, by using this data as well as the counts, one can calculate the specific activity of these compounds. (auth)

22989 AN ASSEMBLY FOR $C^{14}O_2$ COLLECTION IN METABOLIC STUDIES FOR LIQUID SCINTILLATION COUNTING. Dianna Cuppy and Lamar Crevasse (Univ. of Florida, Gainesville). Anal. Biochem., 5: 462-3(May 1963). (In English)

An inexpensive method for multiple determinations in

metabolic studies of oxidation of C^{14} substrates for subsequent liquid scintillation counting is presented. Complete transfer of $C^{14}O_2$ trapped in the collecting vial can be effected in a single operation. (auth)

22990 REVIEWS IN GENETICS AND CYTOLOGY. I. PLANT BREEDING. C. J. Bishop (Canada Dept. of Agriculture, Ottawa). Can. J. Genet. Cytol., 5: 1-11 (Mar. 1963).

A review of recent plant breeding research in cytology and genetics indicates that there have been many significant accomplisments that have greatly extended our basic knowledge in this field. Major developments are reviewed. (C.H.)

22991 SYNTHESIS OF TRITIUM-LABELED PHENOTHIAZINES. F. Kalberer and J. Rutschmann (Sandoz AG, Basel). Helv. Chim. Acta, 46: 586-91(1963). (In German)

A general method for labeling phenothiazines at specific positions in the ring with tritium is described. Specific activities of several hundreds of mc/mm are attainable. (auth)

22992 REVIEW OF CHELATION IN PLANT NUTRITION. Arthur Wallace (Univ. of California, Los Angeles). J. Agr. Food Chem., 11: 103-7(Mar.-Apr. 1963). (TID-16886)

The use of synthetic chelating agents as a means of supplying Fe and to a lesser extent Zn and Mn to plants is increasing. The manner in which chelating agents function is not as yet fully understood. Chelating agents and their metal components can be absorbed by plant roots and transported to leaves, but there is evidence that chelating agents do not penetrate plant cells. Especially under low pH conditions the chelating agent either remains outside the plant root or is excreted by the plant root with only the metal component being accumulated. At high pH, there is a greater tendency for accumulation of both components. Some chelating agents increase yields independently of their effect on supplying deficient micronutrients. This effect continues to be investigated and may be of practical importance. (auth)

22993 A NEW RECTAL RADIUM APPLICATOR. Richard W. Pullum. J. Am. Osteopath. Assoc., 62: 294-8 (Dec. 1962).

The applicator, called the Pullum proctostat, was developed originally in response to the need for an applicator that would allow the administration of an adequate palliative dosage of radiation to an eccentrically situated rectal carcinoma. It was designed to produce a minimum of discomfort during the treatment interval, yet be inexpensive, easy to obtain and use, and give the patient the greatest possible benefit from the radium application. Occlusion of the rectal lumen necessitates some provision for drainage from the rectum or else painful distention will result and perhaps necessitate interruption of the treatment. The proctostat has a rectal tube running through its length and protruding from its internal and external ends. The body of the proctostat, which is made of balsa wood, is responsible for the support and positioning of the radium in the desired location. Placement of the radium cells within the proctostat is accomplished by drilling the required number of holes in the desired location in the body of the applicator. The holes are carefully placed so that when the cells are in place the distance between the radium and the surface being treated will be 0.5 cm. Treatment time is limited to 50 hr or less, and the quantity of radium used is calculated to permit this. Successful results with the device in several patients are described. (TCO)

22994 ABSENCE OF SECONDARY DISEASE IN RATS TREATED WITH HOMOLOGOUS BONE MARROW TRANSFUSIONS AFTER ADMINISTRATION OF "MYLERAN." A. Dunjic (Universite Louvain, Belg.). Nature, 198: 603-4 (May 11, 1963).

Secondary disease did not develop following homologous bone marrow transfusions in rats treated with myleran, a mitotic inhibitor, before irradiation. Data indicate that secondary disease does not occur in intrastrain experiments when rats of a non-inbred but homogeneous strain are used and that in rats the appearance of delayed mortality in interstrain experiments is dependent on the degree of antigenic differences between the donor and the host. A great difference between the two strains of rats did not allow survival even during the first 30 days following irradiation and also administration of myleran. (C.H.)

22995 BONE MARROW TRANSPLANTATION IN APLASTIC (HYPOPLASTIC) ANAEMIAS AND ACUTE LEUKEMIA. A. A. Bagdasarov, M. S. Dul'tsin, F. E. Fainshtein, G. V. Osechenskaya, G. V. Sukyasyan, L. E. Yarustovskaya, M. A. Umnova, and M. I. Nikolayeva (Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 73-83(1961).

Clinical observations are reported on 18 patients with aplastic anemia and acute leukemia treated by bone marrow transplantation. Bone marrow did not improve results in acute leukemia. The transplantation of bone marrow in conjunction with chemical treatment may have had a favorable effect on the course of the disease. (C.H.)

22996 BONE MARROW TRANSPLANTATION IN THE TREATMENT OF ACUTE LEUKEMIAS IN CHILDREN. V. I. Kalinicheva, L. M. Rozanova, D. I. Rafal'son, and L. K. Nikolayeva. Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 99-104(1961).

Observations on 18 patients with acute myeloid leukemia led to the conclusion that treatment with bone marrow transfusions combined with 6-mercaptopurine, corticosteroid hormones, and packed red cell transfusions has a favorable effect on remission and the course of leukemia in children. No cures resulted from this treatment. Best results were obtained when 6-mercaptopurine treatment was followed by 5 or 6 transplantations at intervals of 5 to 7 days. Intraosseous injection of bone marrow did not cause complications when all the rules of asepsis and antisepsis were observed. (C.H.)

22997 CLINICAL OBSERVATIONS ON BONE MARROW TRANSPLANTATION IN THE TREATMENT OF CERTAIN DISEASES OF THE BLOOD SYSTEM. F. A. Efendiyev, A. M. Akhundova, O. Kh. Ter-Mkrtycheva, and Sh. R. Ragimov (Azerbaijan Research Inst. of Hematology and Blood Transfusion, USSR). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 105-7 (1961).

Results are reported on the use of bone marrow transplantation in the treatment of 10 patients, comprising 3 with leukemia, 6 with aplastic and hypoplastic anemia, and 1 with severe pernicious anemia. Each patient received from 2 to 8 bone marrow transplants at intervals of 7 to 15 days. Intrasternal bone marrow injections were given after treatment with corticosteroid hormone, vitamins, and blood transfusions. Intraosseous bone marrow transplantation, combined with other treatment, caused amelioration of the condition in 3 patients with anemia. A significant improvement in general condition and clinical remission was obtained in 2 patients with leukemia. (C.H.)

22998 INITIAL OBSERVATIONS ON BONE MARROW TRANSFUSION IN HYPOPLASTIC AND APLASTIC ANEMIAS. M. I. Shrago, Kh. P. Zalkina, and M. M. Voskoboinikov (Ukrainian Research Inst. of Blood Transfusion and Emergency Surgery, SSR). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 107-9(1961).

Initial observations are reported for 2 patients with hypo- and aplastic anemia who received combined treatment including bone marrow transplantation. The observations confirm the desirability of using bone marrow transplantation in the treatment of certain forms of anemia. (C.H.)

22999 THE USE OF BONE MARROW OBTAINED FROM CADAVERS IN CLINICAL PRACTICE. L. M. Spizharskaya and T. K. Mamysheva (Red Banner Research Inst. of Blood Transfusion, Leningrad). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 119-23 (1961).

A method is described for obtaining bone marrow from cadavers. Examination of bone marrow by fluorescence microscopy led to the conclusion that bone marrow obtained the first 3 to 6 hours after death from cadavers of people who died suddenly may be used in clinical practice. (C.H.)

23000 PROBLEMS OF OBTAINING AND PRESERVING BONE MARROW. A. G. Fedotenkov, N. A. Mefedova, and I. P. Dishkant (Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 124-7(1961).

Methods are described for obtaining and preserving bone marrow from donors and cadavers. A method of freezing bone marrow is described that results in viability of 65 to 80% of bone marrow cells. (C.H.)

23001 THE MORPHOLOGICAL COMPOSITION OF FETAL BONE MARROW UPON STORAGE. L. A. Danilova (Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 128-31(1961).

Examination of the bone marrow from human embryos and fetuses of 12 to 33 weeks gestation led to the conclusion that fetal bone marrow is more suitable for transplantation after the 20th week of intrauterine life. Examination of stored bone marrow showed almost complete decay of the cellular elements of the white series by the 25th to 30th day. Only erythro- and normoblasts were found in bone marrow films at this period. The possibility of using these cells in the treatment of disturbances of erythropoiesis is suggested. (C.H.)

23002 EFFECT OF OXIDATIVE PHOSPHORYLATION INHIBITORS ON SYNTHESIS OF LIVER MITOCHONDRIA PHOSPHOLIPIDS. John N. Youngs and W. E. Cornatzer (Univ. of North Dakota, Grand Forks). Proc. Soc. Exptl. Biol. Med., 112: 308-11(Feb. 1963).

The effect of single doses of arsenate, bilirubin, dinitrophenol, and oligomycin on synthesis of mitochondria phospholipids of liver of rats was studied. A statistically significant decrease occurred in synthesis of phosphatidyl inositol, sphingomyelin, lecithin, phosphatidyl serine, and phosphatidyl ethanolamine of liver mitochondria following administration of dinitrophenol. Administration of arsenate, oligomycin, and bilirubin inhibited statistically the incorporation of the isotope into all the phospholipid fractions of liver mitochondria except sphingomyelin and phosphatidyl inositol. However, oligomycin inhibited incorporation of the isotope into the sphingomyelin fraction and arsenate inhibited the phosphatidyl inositol fraction. (auth)

23003 EFFECT OF TRIETHYLENEMELAMINE (TEM) ON ENDOCRINE SYSTEM OF THE MALE RAT. Samuel A. Gunn, Thelma Clark Gould, and W. A. D. Anderson (Univ. of Miami, Coral Gables, Fla.). Proc. Soc. Exptl. Biol. Med., 112: 614-17(Mar. 1963).

Five to six days following the termination of a 5-day treatment of rats with TEM (0.2 mg/kg daily), the weight and capacity of the dorsolateral prostate to take up Zn^{65} was diminished, indicative of a diminished androgen level. Dorsolateral prostate weight and Zn^{65} uptake were maintained in TEM-treated rats by administration of testosterone, pituitary ICSH, or chorionic gonadotrophin. (auth)

23004 RELATION BETWEEN ERYTHROPOIETIN PLASMA LEVEL AND OXYGEN REQUIREMENTS. Jean-Pierre Naets (Univ. of California, Berkeley). Proc. Soc. Exptl. Biol. Med., 112: 832-6(Apr. 1963).

The level of erythropoietin was measured in the plasma of starved or hypophysectomized rats with lowered oxygen requirement after stimulation by hypoxia, cobalt, or anemia. Also, polycythemic rats were submitted to hypoxia or cobalt. A reduced erythropoietin response was observed in hypophysectomized and starved rats after stimulation by hypoxia. The diminished response was not so striking after stimulation by cobalt, probably because the concentration of the cobalt in the plasma was higher in these groups. Response to cobalt and hypoxia was also reduced in polycythemic rats. (auth)

23005 MARROW DISTRIBUTION IN RAT FEMURS DETERMINED BY CELL ENUMERATION AND Fe^{59} LABELING. Joseph LoBue, Burton S. Dornfest, Albert S. Gordon, Josephine Hurst, and Henry Quastler (New York Univ., New York). Proc. Soc. Exptl. Biol. Med., 112: 1058-62(Apr. 1963). (BNL-6782)

A radioactive iron method was used in conjunction with a cell enumeration procedure to determine total marrow distribution in rat femurs. With radioiron, approximately 180 to 370 million marrow cells and 100 to 182 mg of marrow were found to be contained within femurs of 260 to 280 g rats; 55% of this marrow was located within the diaphysis whereas the remainder was in epiphyseal regions. Using the cell enumeration procedure, approximately 140 to 325 million marrow cells were found within femurs of 260 to 280 g rats with 65% being located within the diaphyses. (auth)

23006 INITIAL IMPRESSIONS OF THE DIAGNOSTIC USE OF RADIOACTIVE PHOSPHORUS IN OPHTHALMOLOGY. Miodrag Stankovic (Clinic for Eye Diseases and Oncological Inst., Faculty of Medicine, Belgrade). Srpski Arhiv Celokupno Lekar., 90: 1197-1202(Dec. 1962).

Out of 10 cases, the use of radioactive P established four cases of malignant growths on the retina that were histologically confirmed, but gave falsely positive results in two cases immediately after surgical intervention, and was negative in the other four cases. It was concluded that the method appears justified in diagnosing intraocular tumors if regarded as an auxiliary method and not as the decisive factor. (P.C.H.)

23007 USE OF RADIOISOTOPES IN ANIMAL BIOLOGY AND THE MEDICAL SCIENCES. VOLUME 1. Proceedings of a Conference held in Mexico City, 21 November–1 December 1961. New York, Academic Press, 1962. 575p.

Separate abstracts were prepared for 14 papers presented at this conference. Other papers cover the use of radioisotopes as tracers in agricultural and medical studies. (C.H.)

23008 ISOTOPES AND NUCLEAR RADIATIONS IN MEDICINE. A QUARTER CENTURY OF NUCLEAR MEDICINE. John H. Lawrence (Univ. of California, Berkeley). p.1-22 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

Applications of radioisotopes in medical research, diagnostic, and therapeutic procedures are reviewed. Developments during the past 25 years are discussed. 62 references. (C.H.)

23009 THE USE OF RADIOISOTOPES IN PHYSIOLOGY. D. Harold Copp (Univ. of British Columbia, Vancouver). p.23-30 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

Applications of radioisotopes in physiology are reviewed. Emphasis is placed on the use of tracer studies in estimations of the volume of body compartments, in studies of Fe metabolism, in cardiovascular studies, in bone studies, in endocrinology, and in studies of transport across biological membranes. (C.H.)

23010 SOME EXAMPLES OF THE USE OF RADIOISOTOPES IN BIOCHEMISTRY. R. F. Glascock (National Inst. for Research in Dairying, Shinfield, Reading, Eng.). p.49-67 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

Brief summaries are presented of biochemical studies employing radioisotopes. Topics discussed include the use of Cu^{64} in studies of Cu metabolism in swine, the use of Co^{60} to study the synthesis of vitamin B_{12} in herbivores and the metabolism of vitamin B_{12} in rats, the use of tritium-labeled hexoestrol in studies of the distribution of estrogens in female sheep and goats, the use of C^{14}-labeled glucose in studies of glucose catabolism and the tricarboxylic acid cycle in domestic animals, the use of P^{32} and C^{14} as tracers in studies of metabolism in insects, and isotope effects in biochemical studies. (C.H.)

23011 TRITIATED PRECURSORS EMPLOYED FOR THE STUDY OF NUCLEAR FUNCTION AND NUCLEAR REPLICATION. D. M. Prescott (Oak Ridge National Lab., Tenn.). p.71-86 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

The cell nucleus must perform two functions. These include the dissemination of genetic information to the surrounding metabolic system and its own self-replication during cell growth. DNA is thought to impart genetic specificity to RNA in the first case and to act as a template to support synthesis of new DNA in the second case. A biological approach to these problems was made with intact cells using autoradiographic detection of incorporation of tritiated precursors into nucleic acids and proteins. In the ciliated protozoan Tetrahymena, incorporation of tritiated cytidine or uridine took place initially only in the nucleus. Only after a distinct time lag did radioactive RNA appear in the cytoplasm. With removal of the exogenous source of tritiated precursors, radioactive RNA gradually disappeared from the nucleus with a concomitant increase in the amount of radioactivity in the cytoplasm. Individual cells were also cut into nucleated and enucleated fragments and incubated in tritiated uridine or cytidine media. Nucleated fragments incorporated large amounts of radioactivity into RNA; enucleated fragments survived for 24 to 72 h but were completely incapable of precursor incorporation into RNA. Enucleated cells incorporated tritiated histidine into protein, but this activity declined to zero after several hours. This cessation of protein synthesis occurred when the enucleated cells had lost approximately one third of their total RNA. These experiments support the thesis that the nucleus is the exclusive site of RNA synthesis; RNA is transferred continuously from the nucleus to cytoplasm; and there is a special fraction of RNA that is used up during protein synthesis. In the ciliated protozoan Euplotes, DNA replication occurs in two waves that pass slowly through the nucleus. Tritiated thymidine labeling showed that only a few per cent of DNA is engaged in replication at any one moment. Labeling RNA with tritiated uridine demonstrated the absence of RNA or RNA synthesis in the region undergoing DNA synthesis. In all non-replicating regions of the nucleus RNA synthesis was continuous. The experiments showed that DNA does not participate in both DNA and RNA synthesis simultaneously and RNA or RNA synthesis play no direct role in DNA synthesis. (auth)

23012 A FOUR NUCLEOTIDE AND DNA REQUIRING SYSTEM IN MAMMALIAN AND BACTERIAL EXTRACTS FOR THE INCORPORATION OF RIBONUCLEOTIDES INTO RNA. S. B. Weiss and T. Nakamoto (Univ. of Chicago). p.97-123 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

When highly radioactive ribonucleotides (basic subunits of RNA) were incubated with various preparations derived from rat liver nuclei, there was a significant incorporation of radioactivity into the RNA fraction. It was found that optimum incorporation of radioactivity occurred only if all four ribonucleotides were present. Since these four ribonucleotides (cytidylic, adenylic, uridylic and guanylic acid) are the building blocks which form RNA, it was considered important to establish these requirements for a system in which biosynthesis of any specific RNA was under investigation. Further work with the enzyme found in nuclei revealed that the above activity was abolished if the mammalian preparation was first subjected to the action of desoxyribonuclease (DNase), an enzyme which destroys DNA. Reactivation, in part, of the DNase inactivated system could be achieved if purified DNA was re-added. These experiments, using cell-free preparations from mammalian tissue, clearly demonstrated a reaction that had not been observed before, namely, preparations of mammalian nuclei catalyzed the incorporation of ribonucleotides into the framework of RNA and this reaction required that all four ribonucleotides be present as well as DNA. Since it can be demonstrated experimentally that DNA contains genetic information, the fact that DNA is an essential requirement for RNA synthesis seems particularly important. If the reaction described above represents a general mechanism for the biosynthesis of RNA, one might expect to find a similar reaction in other types of living systems such as bacteria, and, indeed, such a reaction can now be shown to occur in a number of microorganisms. At the present time, we have prepared from the bacterium M. lysodeikticus a partially purified enzyme which catalyzes the synthesis of RNA. This enzyme shows an absolute requirement for all four ribonucleotides and DNA: omission of one ribonucleotide or DNA results in no observable reaction. A number of DNAs obtained from different organisms have been tested with this bacterial enzyme, and we have found that DNA from mammalian and bacterial sources prime the reaction equally well. However, when the chemical or physical structure of DNA has been altered, it can no longer prime the reaction for RNA synthesis with the same efficiency as native DNA. Low

molecular weight RNA cannot replace DNA as a primer, but high molecular weight RNA isolated from the infectious Turnip yellow mosaic virus is partially effective in priming the reaction. Some insight into the role played by DNA in this reaction has been obtained by examining the RNA so synthesized for base composition (that is, for the amounts of the different ribonucleotides present in the newly prepared RNA). When purified DNA from Salmon, Pseudomonas, Serratia, and E. coli were used in separate reactions, the ratio of the different ribonucleotides in the RNA synthesized was remarkably similar to the ratio of deoxyribonucleotides found in the primer DNA used. Although base ratio studies of this type are merely statistical and give no information about the exact sequential arrangement of the ribonucleotides in the nucleic acid chain, the similarity in the per cent composition of the bases between a DNA and the RNA synthesis which it primes, implies that the newly formed RNA may well be a replicate of the primer DNA. (auth)

23013 THE LARGE VOLUME LIQUID SCINTILLATION DETECTOR AND ITS USE IN STUDYING THE PHYSIOLOGY, GENETICS AND NUTRITION OF FARM ANIMALS. F. N. Andrews and J. E. Christian (Purdue Univ., Lafayette, Ind.). p.189-98 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

A large volume 2-π liquid scintillation detector, Sinco-P, was constructed at Purdue University under a grant from the Atomic Energy Commission. This instrument is capable of measuring extremely low level gamma activity of large inanimate objects and live animals weighing up to 250 lb. It is particularly suitable for the measurements of naturally occurring K^{40}. Prior to the development of the large liquid scintillation counter the determination of body composition, particularly lean body mass, has been extremely difficult in either the live or dead animal. For the first time it will be practical to make repeated estimations of body composition of live animals such as poultry, swine, calves, sheep, and man, being used in nutritional, physiological and genetic studies. Investigations include observations on K^{40} content of meat animals in relation to species, age, sex, plane of nutrition, genetic composition, hormonal status, and general physiologic state. The pattern of growth in terms of skeleton, muscle, and fat undergoes constant change from birth until sexual maturity, during the period of puberty and again as maturity is reached and aging begins. There are wide differences between animals, between sexes and between feeding systems. The detector is also being used in connection with isotopes such as Na^{22}, K^{42}, I^{131}, Co^{60}, Fe^{59}, Cs^{137}, Cs^{134}, and other gamma emitters. It can play a vital role in the measurement of radioactivity in animal feedstuffs and human food, is of value in studying residue problems involving insecticides, herbicides and pesticides in general, and in studying intermediary metabolism in properly labeled drugs. (auth)

23014 SPONTANEOUS CARCINOGENESIS IN C3H MICE. E. A. Ezz, G. T. Okita, and G. V. Le Roy (Argonne Cancer Research Hospital, Chicago). p.217-34 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

Carbon-14 was used as a tracer in studies of metabolism in neoplastic and uninvolved tissues of mice with mammary tumors. Factors affecting spontaneous carcinogenesis in mice are discussed. (C.H.)

23015 ATTEMPTS TO CLARIFY THE PHYSIOLOGICAL MEANING OF RESULTS WITH METABOLIC TRACERS BY THE HELP OF AN ANALOG COMPUTER. M. Kleiber, J. J. Kaneko, and A. L. Black (Univ. of California, Davis). p.253-77 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

The use of tracers in metabolic research has opened approaches to metabolic problems which before could not be investigated. It has led to changes in basic ideas about metabolism. Some of the new kinetic concepts that have evolved are not yet as clear as would be desirable. This applies especially to metabolic pool and its turnover rate. A hydraulic analog computer has been constructed with the aim of studying theoretically the extent to which the tracer concentration vs. time curves for various pools may indicate pool sizes and turnover rates. The pools are represented by given amounts of water in flasks connected by syringe pumps. The dye T-1824 is injected into the analog of the circulatory pool. The optical density measured by a spectrophotometer represents the tracer concentration; time is represented by the number of cycles of the syringe pumps. Aside from pool size and turnover rate we shall discuss transfer quotient and transfer ratio, concepts important in analyzing results of tracer trials with animals for gaining information on precursor product relationships. The effect of recycling in a metabolic process on the labeling level and labeling pattern of animal products is discussed. (auth)

23016 WATER SPACES OF BRAIN STUDIED WITH RADIOISOTOPIC INDICATORS. Charles F. Barlow and Lloyd J. Roth (Univ. of Chicago). p.279-94 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

The regional anatomical variation in water spaces of the central nervous system of immature and adult cats were examined employing radioisotopic substances as indicators. The methodology combined the qualitative representation of radioactivity by means of serial autoradiograms with radioassay of a number of dissected anatomical brain structures plus plasma and cerebrospinal fluid. The findings are correlated with the electron microscopic findings in nervous tissue. Sulfate labeled with S^{35} was employed as an indicator of extracellular brain water. At a steady level in brain and plasma, the data reveal a sulfate space of approximately 4% of wet weight in all brain regions in the adult cat. This correlates well with the virtual absence of extracellular spaces suggested by electron micrographs of brain and contrasts sharply with the 30% chloride space of brain. The sulfate space of the newborn cat is distinctly larger and displays marked regional variation, cerebral cortex 16.8% and cerebral white matter 33.5%. In contrast to the limited entry of sulfate, the entry of a substance into total brain water was also investigated. Urea labeled with C^{14} serves to depict the entry of such a substance. After a single injection of a tracer dose of urea it was found that it required 6 h for cerebral cortex to equal plasma and 12 h for white matter to attain similar values. We have suggested that the lesser penetration into white matter is related to the well established electron microscopic observation of the lamellated membranes which constitute the myelin sheath. Such a structure might be expected to pose considerable hindrance to entry. In the newborn kitten, an age when no myelin has appeared in cerebral white matter, the urea concentration of cortex and white matter was equal after 1 h giving additional support to this proposal. The phenomenon of slower entry into white matter was also observed in our studies of the regional entry of C^{14}-phenobarbital, C^{14}-thiopental, C^{14}-barbital and C^{14}-

diphenylhydantoin. Thus, slow entry into myelinated regions was found with compounds of quite different physical properties and rates of entry into brain. These findings are considered in relation to the blood-brain barrier. (auth)

23017 STUDIES ON THE RELATIONSHIP BETWEEN ERYTHROPOIETIC ACTIVITY AND IRON ABSORPTION. G. A. Mendel (Argonne Cancer Research Hospital, Chicago). p.331-41 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

It has been suggested that a direct relationship exists between the rate of erythropoiesis and absorption of iron from the gastrointestinal tract. Experiments were conducted in mice to study this relationship and to attempt to delineate the mechanism by which bone marrow activity influences gastrointestinal mucosal cells. Hypertransfusion effectively reduces erythropoietic activity and iron absorption from the gastrointestinal tract. In hypertransfused mice, an increase in iron absorption occurred when erythropoietin was administered and a test dose of radioiron was fed at the time of reticulocyte response. In hypertransfused mice rendered incapable of reticulocyte response to erythropoietin by splenectomy and administration of Sr^{89}, there was no increase in iron absorption following injection of erythropoietin. While iron absorption in hypertransfused mice was reduced to one-third normal, there was little reduction of absorption in mice which had erythroid activity reduced to approximately one-tenth normal by splenectomy and administration of Sr^{89}. Splenectomized, Sr^{89} treated mice showed a two-fold increase in absorption when subjected to a hypoxic stimulus, although no stimulation of erythropoiesis occurred. It would therefore appear that erythropoietin is capable of enhancing iron absorption, this effect of erythropoietin is indirect, marked reduction in rate of erythropoiesis is not necessarily accompanied by marked reduction in iron absorption, iron absorption may be increased without increasing erythroid activity, and the mechanism of enhancement of iron absorption in hypoxic mice may differ from that in erythropoietin-treated mice. (auth)

23018 RADIOIRON STUDY OF ERYTHROPOIESIS AFTER X-IRRADIATION. T. G. Hennessy and J. P. Okunewick (Univ. of California, Los Angeles). p.357-61 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

It was demonstrated that the fraction of an intravenously administered dose of radioiron that appeared in the circulating erythrocytes of rats was greatly depressed by doses of ionizing radiation of 125 and 250 r. In this initial study the radioiron was administered at 25 or 48 h after irradiation and the depression in radioiron uptake of the cells could be observed as late as 20 days after the irradiation. Since histological and other evidence indicated that the erythropoiesis in the bone marrow of rats following irradiation doses of this magnitude does not remain depressed for 20 days, it was concluded that the radioiron uptake was evidence of the bone marrow function in the period immediately following the intravenous injection of the radioiron. A group of Wistar rats were given 100 r of 200 Kvp x rays. Daily, from 1 to 34 days after irradiation, three animals from the irradiated group were selected for radioiron uptake studies and their uptake compared with control unirradiated animals. The curve constructed from these radioiron uptake studies clearly demonstrates the initial depression of the erythropoietic activity of the bone marrow, the subsequent recovery phase with bone marrow activity above normal by 1 week following the irradiation, and the return to normal levels by 2 weeks following the irradiation. (auth)

23019 RADIATION DAMAGE TO THE STEM CELL. Clifford W. Gurney, N. Wackman, and L. O. Jacobson (Argonne Cancer Research Hospital, Chicago and Univ. of Chicago). p.363-70 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1." New York, Academic Press, 1962. (In English)

The extent of damage to stem cells was measured in the mouse as a function of the dose of whole-body x radiation. The response in the hypertransfused mouse to a standard injection of erythropoietin was used as a model. Following transfusion of red cells of the same species until hematocrits exceeded 70%, erythropoiesis in young CF No. 1 mice ceased. Forty-eight h after subcutaneous administration of 6 units of erythropoietin, 1 μc of Fe^{59} citrate was given intravenously. Four days later the percentage of the tracer dose in the newly-formed peripheral red cells, produced as a consequence of stimulation of the stem cell compartment by erythropoietin, was found to be 27%. Mice receiving total-body irradiation immediately prior to the administration of erythropoietin showed impairment of response as measured by Fe^{59} incorporation in newly-formed red cells. Fifty roentgens decreased the average radioiron incorporation to 19%, and when the log of the Fe^{59} incorporation was plotted against the roentgens administered, a linear relationship was obtained over the range 0 to 300 r. At 300 r, less than 2% of the tracer dose was incorporated. Since recognizable red cell precursors were absent from the reticulum at the time of irradiation, it is concluded that the reduction of effective erythropoiesis demonstrated in these animals is a measure of the radiation effect on the stem cell. Using this model, many aspects of damage and recovery to stem cells following irradiation can be determined quantitatively. (auth)

23020 METABOLISM OF ^{131}I IN SHEEP AND SWINE. L. K. Bustad, C. M. Barnes, L. A. George, et al. (General Electric Co., Richland, Wash.). p.401-14 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 1" New York, Academic Press, 1962). (HW-SA-2267) (In English)

Studies performed over a 10-year period on the metabolism of I^{131} in sheep and swine following single and daily administration are summarized. On a daily feeding regimen of I^{131}, a seasonal cyclic uptake was observed with a maximum uptake from August to January and minimum uptake from April to July. Pregnancy and lactation probably affect this seasonal variation; temperature and photoperiodicity are also considered contributory. A change in thyroid uptake with age was also observed. Thyroidal I^{131} uptake was found to be dependent on the quantity of stable iodine and the presence of certain drugs and feed components in the ration. The thyroid of fetal sheep was observed to begin uptake of radioiodine at about 50 days after gestation. Thyroidal I^{131} concentration increased exponentially until the latter part of gestation. During the last month of pregnancy the thyroid of the fetus may show three times the concentration of the dam's thyroid. In swine in advanced pregnancy, thyroids of the fetus and dam exhibited similar I^{131} concentrations. The fetal thyroid ability to form iodotyrosines, triiodothyronine, and thyroxine was noted even while fetal thyroidal iodine concentrating ability was minimal. The mechanism for thyroxine synthesis is, therefore, differentiated in sheep

long before the adult rate of hormone synthesis is attained. Using a whole-body monitor, the body burden of I^{131} was determined. The I^{131} content of lambs' thyroids was found to approach a constant fraction (~70%) of the I^{131} in their bodies by 3 to 5 days. In young lambs the percentage uptake of radioiodine in the thyroid was independent of whether their milk was labeled in vivo or in vitro. At equilibrium, concentrations of I^{131} in various tissues, secretions and excretions of sheep were found to occur in the following descending order: thyroid, faeces, mandibular salivary gland, milk, urine, parotid gland, liver, ovary, kidney, adrenal, pituitary, lung, lacrimal gland, heart, pancreas, blood, spleen, thymus, brain and lens. In miniature swine the thyroid uptake pattern resembled that of man. (auth)

23021 USE OF RADIOISOTOPES IN ANIMAL BIOLOGY AND THE MEDICAL SCIENCES. VOLUME 2. Proceedings of a Conference held in Mexico City, 21 November-1 December 1961. New York, Academic Press, 1962. 339p.

Separate abstracts were prepared for 9 papers included in this volume. Other papers cover various aspects of the use of radioisotopes in studies on mineral metabolism, lactation and metabolism in cows, and clinical studies. (C.H.)

23022 A METHOD FOR STUDY OF THE KINETICS OF INTESTINAL ABSORPTION OF RADIOACTIVE INORGANIC IONS. G. Michon and M. J. Maillard (CEN, Fontenay-aux-Roses, France). p.3-19 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In French)

Results are reported from studies of the kinetics of mineral ion absorption by the digestive organs and the determination of the constants governing the passage of such substances through the body. Work on this subject is valuable from the standpoint of treating cases involving the accidental ingestion of radioisotopes. The technique used is based on the immediate and continuous recording of the radioactivity present in the blood after a radioisotope has been administered and on the interpretation of the curves obtained with the help of suitable mathematical models. The simple or crossed parabiotic circulation techniques employed with rats and the equipment used to measure and record beta or gamma activity in the blood are described. The various ways in which the element can be administered, and the drawbacks and advantage of each method are reviewed. The curves obtained in different sets of conditions are compared graphically and the effect of the quantity administered is analyzed. A mathematical model containing a number of compartments equal to or greater by one than the number of exponential terms obtained from the analysis of the curve is generally sufficient to elucidate the whole. The fact that the result of intestinal absorption is observed in the second compartment involves a certain amount of inaccuracy and uncertainty, which can only be overcome by carrying out additional investigations. It is useful, for example, if information is available on how the distribution pattern of the element under observation varies as a function of time in different organs, and it is vital to have exact data on the behavior of the same element in the blood. These items can be elucidated by recording the radioactivity present in the blood following intravascular injections or in the course of intestinal absorption studies; in the latter case, absorption has to be blocked by binding the mesenteric vessels. The data provide a reasonable basis for solving the system from the point of view of the terms which represent the exchange taking place between the first and second compartments, i.e., the intestinal loop and the circulating medium. Examples are discussed in connection with the absorption of alkaline-earth ions by the intestine, with particular reference to Sr^{90}. (C.H.)

23023 UPTAKE AND RETENTION OF Sr^{90} IN SOFT AND HARD TISSUES AND BONE TUMOURS STUDIED BY MEANS OF AUTORADIOGRAPHY. A. Nilsson and S. Ullberg (Försvarets Forskningsanstalt, Sundbyberg, Sweden). p.21-32 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In English)

A comprehensive investigation was made of the distribution of Sr^{90} in normal mice and mice with Sr^{90}-induced tumors and metastases derived from them. The normal mice were examined at times varying between five minutes and ten months after a single injected dose. Autoradiographs showed Sr^{90} distribution in thin sagittal sections through whole mice. The Sr^{90} uptake in and subsequent disappearance from the soft tissues and the gradual selective accumulation in the hard tissues was demonstrated. For quantitative estimation of the storage of Sr^{90} in various hard tissue areas at different times densitometric measurements were made using as reference a Sr^{90} staircase with known concentrations of radioactivity. Sr^{90}-induced osteolytic as well as osteosclerotic tumors were transplanted isologeously using CBA mice. The uptake and retention in these tumors was studied. The pattern of dissemination of metastases was investigated in animals that had received a Sr^{90} injection some hours before being killed, which made possible autoradiographic localization of even very small metastases. (auth)

23024 EFFECT OF VITAMIN D ON THE MOVEMENT OF ISOTOPES OF ELEMENTS OF GROUPS IIA AND IIB IN CHICKS. N. A. Worker and B. B. Migicovsky (National Research Council, Ottawa). p.41-50 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In English)

Experiments were carried out with rachitic chicks to determine the effect of vitamin D on the movement into bone of oral and subcutaneous doses of Be^{7}, Mg^{28}, Ca^{45}, Sr^{85}, Ba^{131}, Zn^{65}, Cd^{115}, and Hg^{203}. Vitamin D increased the degree of deposition in bone of all the above mentioned isotopes, except Hg^{203}, when the isotopes were administered orally. No significant effect of vitamin D was observed when the elements were administered subcutaneously. This leads to the conclusion that vitamin D exerts a generalized absorption effect. Observed ratios for several of the elements relative to Ca^{45} were measured and the effect of vitamin D on the ratios was noted. (auth)

23025 NATURAL AND FISSION PRODUCT GAMMA RADIOACTIVITY OF INDIVIDUAL GREASE WOOL FLEECES. R. Kulwich, M. E. Hourihan, C. E. Terrill, W. M. Beckner, and J. S. Burkle (Dept. of Agriculture, Beltsville, Md. and Naval Hospital, Bethesda, Md.). p.51-61 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In English)

One group of Rambouillet rams was kept at each of four widely separated locations in the United States. At the end of 12 months, during the spring of 1960, each of these 3-year-old rams was sheared. The individual grease wool fleeces were each placed in a separate bag. The term grease wool refers to raw wool, with all the impurities it contains upon shearing. High resolution γ-ray spectrum measurements were made of individual fleeces, using an 8-in. diameter, 4 in.-thick sodium iodide crystal detector. The scintillations produced were viewed by three 3-in.

photomultiplier tubes, the output signal of which was fed into a 256-channel analyzer. The major γ-ray emitter present in these grease wool fleeces was K^{40}. Since the suint or dried perspiration of the sheep is quite high in potassium content, K^{40} γ-ray measurements may provide an estimate of the suint content. The physiological implications of the potassium levels observed are discussed. Cs^{137}, a fission product, was also found to be present in many of the grease wool fleeces. Total γ-ray emission measurements for K^{40} and Cs^{137} γ-rays were made with a large 4-π plastic scintillator detector. The estimated potassium content of individual grease wool fleeces varied considerably, ranging from about 200 to 550 g of potassium. Cs^{137} γ-ray emission levels ranged from a level of radioactivity so low that it was not detected to as much as 58,000 net disintegrations per min from an individual grease wool fleece. Considerable variability was observed in the grease wool fleece K^{40} and Cs^{137} content, both within a group at a given location as well as between fleeces from different locations. The usual scouring process removes the bulk of the γ-ray emitters present in grease wool, so that scoured wool contains only an extremely low level of γ-ray emitters. (auth)

23026 THE USE OF RADIOISOTOPES IN THE STUDY OF THE INFLUENCE OF PARATHYROID HORMONE ON BONE PHYSIOLOGY. R. V. Talmage (Rice Univ., Houston, Tex.). p.71-82 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In English)

Results are reported from studies of the relationship of solid phases of bone to calcium concentrations of body fluids in rats with and without parathyroid glands. There appeared to be two processes concerned with control of the level of ionic calcium in circulating body fluids: one is primarily physico-chemical (represented by the parathyroidectomized condition) in which bone can either supply to, or remove calcium from fluid compartments; the other is the result of parathyroid action, in which bone is dissolved and the salts returned to body fluids against a concentration gradient. Removal of radiocalcium from bone was affected by parathyroid hormone only when the radioactivity was permitted to remain in the animal sufficiently long to penetrate, by processes of growth and exchange, into subepiphyseal and subperiosteal areas of bone. Comparison of removal ratios of radiophosphate to phosphate, and radiocalcium to calcium, from bones of control and parathyroidectomized animals, demonstrated that parathyroid hormone caused the breakdown of well-formed hydroxyapatite crystals. Removal of stable and radiocalcium from animals in sodium chloride acidosis demonstrated that the primary effect of acidosis on the removal of calcium from bone was on the basic equilibration level and not on parathyroid function. Stimulation of parathyroid activity increased the removal of previously incorporated C^{14}-proline from bone. Concurrent studies showing that hydroxproline content of plasma varied directly with parathyroid activity confirmed that parathyroid action on bone resulted in the removal of the matrix and ground substance along with calcium salts. A working hypothesis is presented for the role of the parathyroids and bone in the maintenance of a constant calcium concentration of circulating body fluids, particularly the plasma. (auth)

23027 EFFECT OF CALCIUM AND PHOSPHORUS LEVELS IN THE DIET ON MAGNESIUM METABOLISM IN CHICKENS. H. M. Edwards, Jr., D. Nugara, and J. C. Driggers (Univ. of Georgia, Athens). p.83-93 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In English)

High dietary levels of calcium and/or phosphorus increased the severity of magnesium deficiency in chicks fed diets low in magnesium. These high levels of calcium and/or phosphorus in the diet also increase the quantitative requirement for magnesium by chickens. A series of studies were conducted to determine where and how these effects were mediated in the chicken's body. Experiments were conducted to determine the rate of uptake and distribution of orally and intraperitoneally administered Mg^{28} by chickens that had previously received magnesium deficient and adequate diets containing both low and high levels of dietary phosphorus and calcium. These studies indicated that Mg^{28} is very rapidly absorbed from the gastrointestinal tract and the abdominal cavity and is deposited in largest amounts in the skeleton. Of the soft tissues tested, the heart muscle contained the greatest amount of Mg^{28} followed by the liver, kidney, muscle and others, with the brain containing only very small amounts. The level of phosphorus significantly influenced the amount of Mg^{28} found in blood plasma, red blood cells, and bone, while high levels of calcium influenced only the quantity of Mg^{28} found in bone. These data indicated that phosphorus is effective at the absorption and/or excretion sites while calcium is effective only at the bone deposition site. When Mg^{28} was administered orally to chickens and the excreta collected for 24 h it was found that high phosphorus levels in the diet significantly influenced the quantity of Mg^{28} retained by the birds. Whether this was due to a decrease in absorption of Mg^{28} from the gastrointestinal tract or to increased excretion was then investigated by administering Mg^{28} intraperitoneally and measuring the quantity excreted during the following 24 h period. It was found that the high phosphorus diet significantly increased the quantity of Mg^{28} excreted and significantly decreased the quantity of Mg^{28} present in the blood of the chickens. The results of these experiments show that high levels of dietary phosphorus influence magnesium metabolism at both the intestinal absorption site and at the excretion site of magnesium from the chicken body. Other experiments, utilizing colostomized hens for separation of feces and urine, indicate that the high level of dietary phosphorus is causing increased excretion of endogenous Mg^{28} into the gastrointestinal tract and not into the urine. (auth)

23028 CESIUM, STRONTIUM AND CALCIUM METABOLISM. SOME RECENT DEVELOPMENTS. W. Moore, Jr., C. L. Comar, and R. H. Wasserman (Cornell Univ., Ithaca, N. Y.). p.117-36 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In English)

Mineral metabolism in laboratory and domestic animals has been intensively studied from two interrelated standpoints: the need for understanding the behavior of certain fission elements in the animal body, and equally important the need for knowledge of the normal metabolism of essential minerals. Some of the newer technical developments include the use of recently available radionuclides such as Ca^{47} and I^{125}; the application of multiple tracer techniques to approach certain problems with various combinations of radionuclides and stable elements; the use of fallout Sr^{90} as a tracer; the artificial maintenance of the blood levels of certain radionuclides and other substances; the employment of isolated gut sacs and intestinal loops for controlled studies of absorption and secretion from blood to the gastrointestinal tract; use of whole-body counting to study kinetics of assimilation and retention of minerals in pref-

erence to older methods of collection and measurement of excretion. Studies with Cs^{137} in rats have given data on the kinetics of Cs^{137} movement, absorption, and endogenous secretion; the effect of stable potassium and stable cesium levels; the mechanisms of transport; the kinetics of Cs^{137} movement between fetus and dam. A long-term study with dairy cows established the effect of dietary calcium level on secretion of strontium into milk. In 1958 five heifer calves were placed on a low calcium, and five on a high calcium, diet. Since then they have been bred and carried through a lactation period. Double tracer studies with Ca^{47} and Sr^{85} were done and also representative aliquots of the feed and milk were analyzed for Sr^{90} and stable calcium. The effect of long-term continuous intravenous infusions of various substances (calcium gluconate, strontium chloride, ammonium chloride, EDTA) on secretion of daily ingested radiostrontium into milk was studied. Effects on strontium levels in blood and milk were observed and correlated with renal and hormone function. (auth)

23029 THE ROLE OF THE MAMMARY GLAND IN THE UTILIZATION OF CARBON FROM FATTY ACIDS AND CARBOHYDRATE FOR SYNTHESIS OF AMINO ACIDS IN THE INTACT COW. A. L. Black and M. Kleiber (Univ. of California, Davis). p.137-50 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In English)

Infusion of C^{14}-labeled compounds into the cistern of one-quarter of the mammary gland permits one to study the metabolic activity of the mammary gland in situ. The role of the cow's udder in the utilization of C^{14}-formate, -acetate, -propionate, -butyrate, -glucose, -fructose, and -lactate for the synthesis of several amino acids was studied. Results show that the mammary gland synthesizes most of the non-essential amino acids. Evidence for udder synthesis of amino acids is based on the criterion that amino acids from the infused quarter have a higher specific activity than the same amino acids from the three non-infused quarters. By comparing the specific activities of the various amino acids and their intramolecular C^{14} distribution (determined by assay of individual carbons after stepwise degradation) one has a basis for demonstrating which amino acids can be formed in the udder; which compounds contribute carbon for the synthesis of amino acids and the relative importance of these various compounds; and the pathway for the transfer of carbon to the amino acids recovered from infused and non-infused quarters. (auth)

23030 CLINICAL APPLICATIONS OF ^{125}I. P. V. Harper, K. A. Lathrop, H. L. Endlich, W. Siemens, and R. W. Harrison (Argonne Cancer Research Hospital, Chicago and Univ. of Chicago). p.247-57 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. 2." New York, Academic Press, 1962. (In English)

Development of production methods using thermal neutron activation of xenon has made available large amounts of relatively pure (>98%) isotope. Its advantages as compared to I^{131} are the 60-day half-life provides long shelf-life and permits long-term metabolic studies; the low energy dissipation rate greatly reduces radiation exposure of the patient in, for example, thyroid scanning; the low energy of the principal photon radiation (27.3 Kev) permits greatly reduced crystal size and shielding, and greatly enhanced detector and collimator efficiency. Even apart from these latter advantages, when the same microcurie dosage of I^{125} is used with unmodified equipment, it produces thyroid scans almost indistinguishable from those using I^{131}. In I^{125} Rose Bengal liver scans, metastatic nodules on accessible surfaces of the liver appear with markedly enhanced contrast because the radiation originating in the underlying liver is attenuated in passing through the cold nodule. Since I^{125} may be counted in an ordinary well crystal with 60 to 70% efficiency, studies involving small in vitro samples present no problem. There are, however, serious obstacles to the use of I^{125} where absorption in overlying tissue is important as in quantitative radioiodine uptake studies or brain scanning. (auth)

23031 DISTRIBUTION OF AERIALLY APPLIED MALATHION S^{35} IN A FOREST ECOSYSTEM. R. H. Giles, Jr. and T. J. Peterle (Ohio State Univ., Columbus). IAEA Preprint No. SM-40/29. 42p.

To be published in IAEA Proceedings of the Symposium on the Use and Application of Radioisotopes and Radiation in the Control of Plant and Animal Insect Pests held in Athens, Greece; Apr. 22-26, 1963.

The distribution of S^{35}-malathion (0,0-dimethyl dithiophosphate of diethyl mercaptosuccinate) in a forested area of east-central Ohio, USA, was studied during the summer of 1962. This broad spectrum insecticide was selected for study on the basis of its increased use in the control of many important forest insect pests in deciduous and coniferous forests of the United States. The need for greater knowledge of the ecology of a forested area, coupled with the need for a more complete understanding of the effects of an insecticide on the fauna, provided the unique possibility of studying the problems simultaneously through the utilization of an isotope-labeled insecticide. The distribution of components of the aerial spray within the forest was measured. Electrically-operated air samplers provided estimates of drift off the area; helium-filled balloons bearing frosted glass discs measured above-canopy application; glass discs suspended vertically as well as bark samples measured quantities settling out at different layers in the canopy; glass discs and spotting-enamel paper not only allowed a measure of horizontal distribution but a check of a standard spray distribution detection device. Soil samples and monitoring of marked stakes allowed sub-surface distribution studies. Samples of water from the intermittent streams, insects, mammals, reptiles, and birds indicated the initial and subsequent distribution of the insecticide and its metabolites in the ecosystem. Population studies of the faunal system continued throughout the summers of 1961 and 1962 and a limited amount of survey data will be collected in the summer of 1963. Preliminary results indicate that the insect populations returned to normal in about three weeks and there was no detectable effect on the densities of the vertebrate animals on the sprayed area. (auth)

Biochemistry, Nutrition, and Toxicology

23032 (BNL-6208) USE OF AN ANALOGUE COMPUTER IN STUDIES OF STRONTIUM AND CALCIUM METABOLISM IN MAN. J. S. Robertson and S. H. Cohn (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 15p.

An analog computer was used in the analysis of data on the kinetics of strontium and calcium metabolism in man. Tracer doses of Ca^{47} and Sr^{85} were injected intravenously in 6 adults and subsequent measurements made of activity concentrations in blood, urine, and feces. Retention in the body was measured with a whole-body counter. Results

obtained with the computer are compared with those obtained using a biological model. (C.H.)

23033 (DPSPU-63-30-3) UPTAKE OF RADIONUCLIDES BY FRESH WATER ALGAE AND FISH. R. S. Harvey (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). May 1963. Contract AT(07-2)-1. 11p.

Radionuclide concentrations in fish (bluegill, bass, and catfish) in a nuclear reactor cooling water pond were compared over a nine-month period to select an indicator species for routine environmental monitoring. The bluegill, containing higher concentrations of Zn^{65} and $Sr^{89,90}$, and only slightly lower concentrations of $Cs^{134,137}$, was selected. Complementary monitoring data were obtained from concurrent analyses of water and algae samples. (auth)

23034 (LADC-5481) DETERMINATION OF PROTEIN CONTAMINATION OF DEOXYRIBONUCLEIC ACID BY THE FOLIN-LOWRY METHOD. G. R. Shepherd and P. A. Hopkins (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract W-7405-eng-36. 10p.

The applicability of the Folin-Lowry protein assay to the determination of protein contamination of DNA was investigated with respect to its sensitivity and to the color contribution of possible degradative contaminants. Quantities of protamine and histone on the order of 10 to 15 μg may be detected by this method, which may be applied to preparations of DNA from which phenol, bases, nucleosides, and nucleotides have been removed. (auth)

23035 (NLCO-869) CORRELATION BETWEEN TWO-STAGE AIR SAMPLING DATA AND THE EXCRETION OF URANIUM IN URINE. Robert L. Fischoff (National Lead Co. of Ohio, Cincinnati). [Apr. 1963]. Contract AT(30-1)-1156. 24p.

A study was conducted to determine the relationship between the concentration of uranium in the air when separated into respirable and non-respirable fractions and the concentration of uranium in the urine of 25 men working at four different operations where exposure to dust and fumes of insoluble uranium could occur. During the 6 months of investigation, approximately 400 biological and environmental samples were collected. In general, it was found that the concentration of uranium in urine varied with the airborne concentration of uranium in air, but the closest relationship was found between the concentration of uranium in urine and the respirable fraction present in air. It was also found that the ratios of the concentration of uranium in the urine to that of the respirable uranium dust for each of the operations varied less than did the ratios when total uranium in the air was considered. It would appear from this investigation that no distinction can be made between soluble and insoluble compounds of uranium, when the particles are as small as those commonly found in industrial fumes. (auth)

23036 (TID-16185) PATTERNS OF RADIUM RETENTION IN MICE AS RELATED TO MAN. Asher J. Finkel and Charles E. Miller (Argonne National Lab., Ill.). May 1962. Contract [W-31-109-eng-38]. 7p. (UAC-6443)

Results are reported from studies on Ra retention in mice fed Ra-containing food starting at the age of 3 months. Separate groups of mice were fed 22 μc of Ra^{226}/kg of food for 7, 14, 28, 56, 84, or 112 days. The Ra content of the body was followed by means of γ ray spectroscopy. Calculations were made of maximum Ra burden after continuous ingestion. Extrapolation of the findings to Ra retention in man is discussed. (C.H.)

23037 (TID-18622) THE RETENTION, EFFECTS, AND CLEARANCE OF INHALED RADIOACTIVE PARTICULATES. Final Report. C. W. LaBelle, H. Brieger, and D. M. Bevilacqua (Jefferson Medical Coll., Philadelphia). [1961]. Contract AT(30-1)-1861. 104p.

A therapeutic regimen is suggested for the treatment of persons accidentally exposed to large inhalation doses of radioactive or other noxious particles. The treatment consists of the inhalation of inert carbon particles, the administration of expectorant drugs, and the use of a semi-liquid diet to facilitate gastrointestinal transport. Animals treated in this manner show a three-fold reduction in pulmonary and whole-body burdens as compared to untreated controls. (auth)

23038 (TID-18649) STRONTIUM 90 LEVELS IN THE DIETS AND BONES OF CHILDREN. Progress Report. (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). [1962]. Contract AT(30-1)-2753. 17p.

Data are presented on the Sr^{90} content of diet and bones of young children in Argentina. It is pointed out that Sr^{90} fallout in Argentina has remained relatively constant during the period from 1959 through 1962 and that the diet history of very young children could be established with some reliability. (C.H.)

23039 (AEC-tr-5794) BEHAVIOR OF THE PROTEINS OF LYOPHILIZED GLUTEN AFTER TREATMENT WITH GAMMA RAYS. A. R. Deschreider. Translated from Ind. Aliment. Agr. (Paris), 78: 243-52(Mar. 1961). 34p. (Includes original, 11p.).

The effects of gamma radiation on lyophilized gluten was studied with respect to the effects on electrophoresis, chromatography, absorption in ultraviolet light, and the solubilities in different solvents. In addition to indexes showing that a dislocation of molecules takes place, there are others that prove that the molecular rearrangements lead, as a consequence, to condensations or polymerizations. Molecular rearrangements were reflected in a general increase of the absorption of the proteins in ultraviolet light, particularly in the region of aromatic amino acids, a decrease in water solubility, and a modification of the ratios existing between the sulfur-containing amino acids and their derivatives. The denaturations of proteins, on the other hand, were observed through the modifications of electrophoretic distribution as well as through the solubility increases of proteins and free amino acids in certain solvents. The magnitude of the phenomena, whatever they may be, depends on the dose of gamma radiation applied and on the nature of the gluten. The breadmaking value of the flours improved to some extent at relatively weak radiation doses. (P.C.H.)

23040 (AEC-tr-5798) BEHAVIOR OF GLUTEN PROTEINS IN TREATMENT OF FLOUR WITH GAMMA RAYS. A. R. Deschreider. Translated from Getreide Mehl, 10: No. 5, 49-54(1960). 21p. (Includes original, 6p.).

Investigations were made on the effects of gamma irradiation on gluten proteins in wheat flour. The results confirm the existence of a polymerizing effect of gamma rays on gluten-protein molecules. The plastic properties of domestic flour can be favorably influenced through the application of weak radiation doses. In addition, the gluten experiences a modification which, at high radiation doses, is particularly pronounced in the case of domestic flours. Accordingly only small doses of ionizing rays, up to 500 krad, can improve the baking value of domestic flours. It is believed possible that through the application of stronger radiation doses to a part of domestic flour, and mixing this with nonirradiated flour, the baking value of the flour could be improved. The assumption is supported by the fact that the properties of the proteins that are not denatured during

the application of such radiation doses are considerably strengthened. (P.C.H.)

23041 ZIRCONIUM LACTATE AND BARIUM ZIRCONATE. ACUTE TOXICITY AND INHALATION EFFECTS IN EXPERIMENTAL ANIMALS. J. R. Brown, E. Mastromatteo, and J. Horwood (Univ. of Toronto). Am. Ind. Hyg. Assoc. J., 24: 131-6(Mar.-Apr. 1963).

The acute oral and intraperitoneal toxicity of Zr lactate and Ba zirconate were investigated in the rat. The oral LD_{50} dose was greater than 10.0 g/kg for Zr lactate and 1.98 g/kg for Ba zirconate. The corresponding intraperitoneal LD_{50} doses were 0.67 and 0.42 g/kg. Groups of 10 guinea pigs, 10 rats, and 10 hamsters were exposed for a period of 225 days to either 15 or 150 mg/m^3 of Zr lactate, to 15 mg/m^3 of Ba zirconate or to room air. Animals exposed to the chemicals showed poor weight gain, pathological changes consistent with a chronic interstitial pneumonitis, very little deposition of fibrous tissue, no granuloma, and an increase in the Zr content of the lung tissue. (auth)

23042 THORIUM DISTRIBUTION AND EXCRETION STUDIES. III. SINGLE INHALATION EXPOSURE TO THE CITRATE COMPLEX AND MULTIPLE INHALATION EXPOSURES TO THE CHLORIDE. Bruce B. Boecker (Univ. of Rochester, N. Y.). Am. Ind. Hyg. Assoc. J., 24: 155-63(Mar.-Apr. 1963).

Thorium distribution and excretion patterns following a single inhalation exposure to a Th citrate complex aerosol were similar to those observed following exposure to a Th chloride aerosol except that the initial absorption of Th from the lungs in the former case was approximately twice that in the latter. Results from multiple exposures to Th chloride aerosols indicated that the inhaled Th in rats exposed 2 to 5 times behaved in a manner similar to those exposed only once. The results are discussed in relation to Th MPC_a (maximum permissible air concentrations) calculations. (auth)

23043 SIGNIFICANCE OF N^{15} EXCESS IN NITROGENOUS COMPOUNDS OF BIOLOGICAL ORIGIN. O. H. Gaebler, Harold C. Choitz, Trieste G. Vitti, and Robert Vukmirovich (Henry Ford Hospital, Detroit). Can. J. Biochem. and Physiol., 41: 1089-97(May 1963).

Studies were made to determine whether the small increase in abundance of N^{15} normally found in nitrogenous compounds of biological origin is due primarily to mass discrimination in nitrogen metabolism, or to reproducible analytical errors. N^{15} was repeatedly determined in the same series of nine amino acids, either purchased in chromatographically pure form or isolated from proteins of rat liver, dog serum, and six plant sources. Proteins and amino acids were selected on the premise that concentration or redistribution of N^{15} might occur in such processes in urea formation, nitrogen transfer, or nitrogen fixation. Data for N^{15} excess in a series of alkaloids were also secured. Standard deviations obtained in the series of analyses were too small, and values for N^{15} excess in the same amino acids isolated from different sources too variable to permit interpreting the observed N^{15} excess as a reproducible error. Distribution of N^{15} in amino acids of the animal proteins studied resembled that observed when N^{15}-labeled amino acids or ammonium compounds are given. Differences between results for amino acids of animal and plant origin also supported the idea that the small excess of N^{15} normally found is metabolically as well as statistically significant. (P.C.H.)

23044 INCORPORATION OF INORGANIC P^{32} INTO PHOSPHOLIPIDS OF BRAIN SLICES. EFFECT OF CERTAIN TRANQUILLIZING DRUGS. W. L. Magee and R. J. Rossiter (Univ. of Western Ontario, London). Can. J. Biochem. and Physiol., 41: 1155-62(May 1963).

Promazine, promethazine, tetrameprazine, and WY 1172 resembled chlorpromazine in that when they were added in a concentration of 0.1 mM to slices of guinea pig brain respiring in a suitable medium they stimulated the incorporation of inorganic P^{32} into the phospholipids of the slices. With one of the drugs, promethazine, the concentration of 0.1 mM was found to cause no significant increase in respiration, in aerobic glycolysis, or in the concentration of phosphocreatine. In higher concentrations (1.0 mM), all of the compounds inhibited the labeling of phospholipid. Promethazine caused a reduction in respiration and in the concentration of phosphocreatine, accompanied by an increase in aerobic glycolysis. Methylene blue did not stimulate the labeling of phospholipid in brain slices. Azacyclonol, pipradrol, and mepazine also stimulated phospholipid labeling in low concentrations and inhibited the labeling at higher concentrations. Piperidine and benzhydrol did not stimulate phospholipid labeling at the concentration that was most effective for azacyclonol. Low concentrations of benzhydrol, however, caused a slight stimulation. Meprobamate and phenaglycodol had either little or no effect. Most of the substances tested inhibited phospholipid labeling when they were added in sufficiently high concentrations. (P.C.H.)

23045 INVESTIGATIONS ON THE ACCUMULATION AND TOXICITY OF RADIUM AND RADIOSTRONTIUM IN THE HUMAN BODY. [PART] II. Pierre Wenger and Charles E. Miller (Centre de Radioactivite Medicale, Geneva). Helv. Chim. Acta, 46: 467-79(1963). (In French)

The urinary excretion of two persons contaminated by Sr^{90} was followed for 34 weeks. The excretion curve of one of these persons, whose contamination ceased 940 days before the beginning of the analyses, and which corresponds to a period of slow elimination, indicates a half-time value of 2502 days. The curve of the other one, which has been taken just after contamination ceased and which corresponds therefore to a period of more rapid elimination, indicates a half-time value of 337 days. (auth)

23046 INVESTIGATIONS ON THE ACCUMULATION AND TOXICITY OF RADIUM AND RADIOSTRONTIUM IN THE HUMAN BODY. [PART] III. Pierre Wenger and Kyriacos Soucas (Centre de Radioactivite Medicale, Geneva). Helv. Chim. Acta, 46: 479-82(1963). (In French)

The construction characteristics of the Geneva Whole Body Counter are given and the techniques used for measuring the subjects and calibrating natural potassium, Cs^{137}, and radium contamination in humans are described. The radium body burdens of a first series of 70 professionally contaminated cases are given. (auth)

23047 PROPERTIES OF THE O^{18} EXCHANGE REACTION CATALYZED BY HEAVY MEROMYOSIN. Ralph G. Yount and D. E. Koshland, Jr. (Brookhaven National Lab., Upton, N. Y.). J. Biol. Chem., 238: 1708-13(May 1963).

Heavy meromyosin (H-meromyosin) in the presence of Mg^{++} catalyzes the incorporation of O^{18} from solvent water into the P_i released from adenosine triphosphate (ATP), dATP, and cytidine, inosine, uridine, and guanosine triphosphates. Tripolyphosphate under the same conditions does not undergo the O^{18} exchange reaction with either myosin or H-meromyosin. The H-meromyosin catalyzed O^{18} exchange with Mg^{++} ATP is independent of hydrogen ion concentration between pH 5.5 and pH 9.3. The ATPase-dependence of H-meromyosin on divalent metal ion radius

and on pH has been found to correspond to that of myosin systems. A rough correlation was found between the divalent metal ions required for contraction, for optimal O^{18} exchange, and for strong complexing with ATP^{-4}. A parallelism exists between the substrates giving the maximal amount of tension and those giving the maximal amount of exchange. It is suggested that some amino acids at the active site of myosin are common to the exchange reaction and the contractile process. (auth)

23048 THE EFFECT OF ISOTOPIC SUBSTITUTION ON THE LIVING CELL. David Rittenberg (Columbia Univ., New York). J. Chim. Phys., 60: 318-23(Jan.-Feb. 1963). (In English)

The discovery of deuterium and the subsequent concentration of the less abundant stable isotopes of hydrogen, oxygen, and nitrogen had an influence on the development of biochemistry. It provided a procedure for labeling the naturally occurring organic constituents of the living cell and studying their transport and metabolism in the intact cell. Replacement of H_2O by D_2O or H_2O^{18} leads to interference in the delicately synchronized net of chemical reactions in the cell. This leads to inhibition of growth and division. It is likely that these phenomena are connected with changes in the tertiary structure of the proteins and the nucleic acids. (auth)

23049 EFFECT OF THE SUBSTITUTION OF D_2O FOR H_2O ON THE ACTIVITY OF PHOSPHOPYRUVIC KINASE IN THE PRESENCE OF ALKALINE IONS. Rose Coelho and Ingrid Pinset-Haerstroem (CEN, Saclay, France). J. Chim. Phys., 60: 324-7(Jan.-Feb. 1963). (In French)

The enzymatic transfer of the phosphate of phosphoenol pyruvic acid to adenosine diphosphate is activated by the alkaline ions K^+, Rb^+, and Na^+ in the ratio 100 : 56 : 15. The isotopic effect observed during the substitution of H_2O by D_2O varies according to the nature of the ion used as activator. With 100% D_2O (extrapolated values) it is 60, 35, and 10% in the presence of K^+, Rb^+, and Na^+, respectively. (tr-auth)

23050 THE EFFECT OF COMPLETE SUBSTITUTION OF D FOR H IN SUCCINIC ACID DEHYDROGENASE ON ITS ENZYMIC ACTIVITY. S. M. Rittenberg and E. Borek (Columbia Univ., New York). J. Chim. Phys., 60: 328-31 (Jan.-Feb. 1963). (In English)

A completely deuteriated enzyme, succinic dehydrogenase, was prepared by growing E. coli in medium containing 99.5 atom % excess deuterium. Kinetic studies were carried out using normal and deuterio-enzyme and substrate. The isotope effect noted when normal enzymes act on deuteriosuccinate was abolished when heavy enzymes acted on deuteriosuccinate. Malonate inhibition studies of the enzyme suggest structural changes are responsible. The implications of these findings are discussed. (auth)

23051 UPTAKE BY THE ROOT AND SUBSEQUENT DISTRIBUTION WITHIN THE POTATO PLANT OF STRONTIUM-89 LEACHED FROM THE FOLIAGE. R. A. Mecklenburg and H. B. Tukey, Jr. (Cornell Univ., Ithaca, N. Y.). Nature, 198: 562-3(May 11, 1963).

Strontium-89 distribution in potato plants, (Solanum tuberosum), was followed after foliar application. Results indicate that Sr^{89} that is deposited on potato foliage is accumulated in underground tubers by foliar leaching and root absorption rather than via basipetal transport from the foliage. Pathways for tuber contamination by fallout are discussed. (C.H.)

23052 STABILITIES OF SOME ALKALINE EARTH CHELATES OF TETRACYCLINE. D. C. Maxwell, P. J. A. Smith, and S. P. Wilford (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nature, 198: 577-8 (May 11, 1963).

Theoretical work has indicated that a suitable reagent for the removal of strontium isotopes from the mammalian skeleton should have a greater affinity for Sr than for Ca. The chelation of Sr, Ca, and Mg with tetracycline was examined. A potentiometric titration method was used to determine the acid dissociation constants of tetracycline and the stability constants of its Mg, Ca, and Sr chelates in an aqueous system. Data are tabulated. It was concluded that this compound would be of little value for the removal of strontium isotopes from the mammalian skeleton. (C.H.)

23053 RADIOACTIVITY IN SOME AQUATIC PLANTS. Paul R. Burkholder (Columbia Univ., New York). Nature, 198: 601-3(May 11, 1963).

A study was made of total β-radioactivity of 196 samples of aquatic plants obtained from fresh water lakes and the sea between July and November 1962. The samples included many kinds of phytoplankton, 20 genera of marine algae, and 14 genera of aquatic flowering plants collected from the New England coast, Bermuda, and Puerto Rico. Results indicate that radionuclides are accumulated by diverse kinds of aquatic plants. (C.H.)

23054 CALIBRATION OF CAESIUM-137 CONTENT IN THE HUMAN BODY. T. A. Iinuma, N. Nohara, T. Nagai, and R. Ichikawa (National Inst. of Radiological Sciences, Chiba, Japan). Nature, 198: 604-5(May 11, 1963).

Calibration of Cs^{137} content in the human body was made using a whole-body counter with NaI (thallium) crystals. $Cs^{132}Cl$ in water solution was then administered to male and female patients and the absolute activity of Cs^{132}, in terms of disintegrations per min equivalent to Cs^{137}, was evaluated by intercomparison with Cs^{137} standard sources. The distribution of Cs^{132} in the body of both patients was determined. Standard chair geometry was compared with scanning geometry. Results indicate that individual body build effects scanning geometry during whole-body counting and that the standard chair geometry has higher sensitivity than the scanning geometry. (C.H.)

23055 EFFECT OF DIETHYLENETRIAMINE-PENTAACETIC ACID AND POLYPROPYLENOGLYCOL-ETHYLENE OXIDE POLYMER ON EXCRETION OF INHALED $^{239}PuO_2$ IN DOGS. E. G. Tombropoulos, W. J. Bair, and J. F. Park (General Electric Co., Richland, Wash.). Nature, 198: 703-4(May 18, 1963). (HW-SA-2885)

Results are reported of tests on the effectiveness of DTPA and Pluronics F68 in removing plutonium from beagle dogs following inhalation of $Pu^{239}O_2$. Pluronics F68, a surface-active agent, was more effective than DTPA, but the effect was not large. (D.L.C.)

23056 EXTRA-UTERINE RE-CIRCULATION OF IODINE-131 FROM THE YOUNG MOTHER IN RATS. M. Samel, A. Čaputa, and L. Struhárová (Endocrinological Inst. SAV, Czechoslovak Academy of Sciences, Bratislava). Nature, 198: 489(May 4, 1963).

Iodine-131 was used as a tracer in studies on the ingestion by the mother of urine excreted by immature rats. The possibility is suggested that in species that immature new-born animals the mother may be responsible for maintenance of their normal internal environment in a manner very similar to that occurring during intra-uterine life. (C.H.)

23057 RESIN METABOLISM IN THE SAPWOOD OF PINUS RADIATA. A. T. Wilson, J. M. Gumbley, and D. J. Spedding (Victoria Univ. of Wellington, N. Z.). Nature, 198: 500(May 4, 1963).

Carbon-14 produced in nuclear explosions was used as a tracer to examine resin metabolism in Pinus radiata. Annual rings of trees were ground and the resin extracted. The C^{12}:C^{13} and C^{14} ratio of each sample was determined. Results indicate that all the resin activity is considerably lower than that of the atmosphere at the time the tree was felled; resin in sapwood is not in metabolic equilibrium with the metabolism of the tree; resin has a long metabolic half-life; and mixing requires many years. (C.H.)

23058 THE INFLUENCE OF LEVELS AND SOURCES OF CALCIUM AND VITAMIN D_3 ON THE BIOLOGICAL HALF-LIFE OF Ca^{45} IN THE CHICK. D. B. Bragg, W. G. Martin, and H. Patrick (West Virginia Univ., Morgantown). Poultry Sci., 41: 1797-1800(Nov. 1962).

Studies in White Leghorn cockerels showed that the biological half life of Ca^{45} in vitamin D_3-adequate chicks fed 1.2% Ca diets was 36 days. The biological half life was increased by reducing the dietary vitamin D_3 and/or Ca level and decreased by raising the dietary vitamin D_3 and/or Ca level. The variation is dependent on the change in each dietary constituent and is not additive when both the dietary level of vitamin D_3 and Ca are changed. The dietary source of Ca as tested by Ca carbonate, lactate, gluconate, and sulfate appears to have a different availability or absorption rate to the bird but not sufficient to produce a significant change in the biological half life of Ca^{45}. No significant differences were observed in the residual tibia Ca^{45} from chicks fed the different Ca salts until after 21 days of age. At 28 days, however, the difference in the retained Ca^{45} between the chicks fed adequate vitamin D_3 and their deficient counterparts became apparent. At this age, chicks receiving Ca lactate did not show the same degree of Ca^{45} turnover between vitamin D_3-adequate and deficient chicks that was shown by the other Ca groups; the difference was ~0.5%. Between 14 and 28 days of age, the chicks fed Ca sulfate without vitamin D_3 showed essentially no change in the Ca^{45} content, but at 35 days a marked decrease in the Ca^{45} concentration was observed. This was also true of the chicks receiving Ca carbonate and gluconate. (H.H.D.)

23059 EFFECT OF A LOW CALCIUM DIET ON BONE CRYSTALLINITY AND SKELETAL UPTAKE OF Ca^{45} IN RATS. J. Menczel, R. Schraer, G. Pakis, A. S. Posner, and R. C. Likins (Dept. of Health, Education, and Welfare, Bethesda, Md.). Proc. Soc. Exptl. Biol. Med., 112: 128-32 (Jan. 1963).

Chemical and x-ray diffraction analyses were performed on femurs of rats receiving a low (0.1%) and high (0.8%) calcium diet with (50 ppm) and without (0 ppm) fluoride supplementation in the water. In addition, uptake of Ca^{45} by the ends and shafts of tibia was determined. Bone crystallinity was not affected by calcium intake, and the improvement in crystal texture produced by fluoride was the same for the high and low calcium groups. Skeletal uptake of radiocalcium was approximately 20 times higher in calcium deficient animals. Fluoride decreased slightly the uptake of radiocalcium. (auth)

23060 RELATIONSHIP BETWEEN DEUTERIUM INHIBITION OF GROWTH AND GLUCOSE CATABOLISM IN SACCHAROMYCES CEREVISIAE. R. T. O'Brien (General Electric Co., Richland, Wash.). Proc. Soc. Exptl. Biol. Med., 112: 186-8(Jan. 1963). (HW-SA-2822)

Deuterium reversibly inhibited yeast growth and glucose catabolism. The similarity between these effects indicated that growth rate depression was primarily due to suppression of glucose catabolism. The latter effect was probably due to inhibition of enzyme reaction rates. (auth)

23061 DIETARY STRONTIUM AND CALCIUM AND DEPOSITION OF Sr^{89} AND Ca^{45} IN THE BONES OF RATS. D. M. Hegsted and Margaret Bresnahan (Harvard Univ., Boston). Proc. Soc. Exptl. Biol. Med., 112: 578-82(Mar. 1963).

Diets containing various levels of stable strontium and calcium and containing low and constant levels of Ca^{45} and Sr^{89} were fed to young rats during a 3 week period. The amounts of the 2 isotopes in the bones were measured. Addition of small amounts of stable Sr, sufficient to reduce the specific activity of the dietary Sr to one-fourth, did not decrease the deposition of radio-Sr and may have caused a slight increase in the deposition of both Ca^{45} and Sr^{89}. Larger amounts of stable Sr were no more effective than calcium in reducing the amounts of the isotopes deposited in the bones. (auth)

23062 EFFECT OF DEUTERIUM OXIDE ON LIPID COMPONENTS OF L-5178Y CELLS. George H. Rothblat, Dolores S. Martak, and David Kritchevsky (Wistar Inst. of Anatomy and Biology, Philadelphia). Proc. Soc. Exptl. Biol. Med., 112: 598-601(Mar. 1963).

A comparison was made of the relative lipid content of L-5178Y cells grown in conventional medium or in the same medium containing 30% D_2O. Cells grown in D_2O medium contain more total lipid. The major increases in the lipids of the D_2O grown cells are due to increases in the levels of triglycerides and sterol esters. There are very few differences in cellular levels of any of the other lipid fractions. Preliminary isotope experiments indicate that the increased lipid content in the D_2O grown cells is due to increased synthesis of lipid. (auth)

23063 RETENTION OF STRONTIUM, CALCIUM, AND PHOSPHORUS IN HUMAN INFANTS. S. A. Lough, J. Rivera, and C. L. Comar (Atomic Energy Commission, Washington, D. C.; New York Operations Office, AEC; and Cornell Univ., Ithaca, N. Y.). Proc. Soc. Exptl. Biol. Med., 112: 631-6(Mar. 1963).

Fifteen-day balance trials were done with 14 healthy infants of about 34 days of age for Sr^{90}, stable strontium, calcium, and phosphorus. Average retentions were: 28% Sr^{90}; −71% Sr; 31% Ca; 30% P. The loss of stable strontium from the body as compared to the retention of the other substances most probably is accounted for by the decreased intake of stable strontium that occurred at the start of the observational feeding period. Dietary Sr^{90} and calcium were added to the bodies of the infants in a ratio that was about 0.9 of the Sr^{90} to calcium ratio existing in the diet. This corresponds approximately to an $OR_{body/diet}$ of 0.9 which contrasts with the accepted value of 0.25 for adults and indicates a lesser capability of the very young to discriminate against strontium in favor of calcium. (auth)

23064 INFLUENCE OF DIETARY VITAMIN E AND SELENIUM ON DISTRIBUTION OF Se^{75} IN THE CHICK. Leo S. Jensen, Elmer D. Walter, and Jack S. Dunlap (Washington State Univ., Pullman). Proc. Soc. Exptl. Biol. Med., 112: 899-901(Apr. 1963).

Three-week-old chicks fed either a vitamin-E−deficient or supplemented diet were intraperitoneally injected with Se^{75}, and distribution of the isotope was determined in various tissues at 24, 48, and 168 hours after injection. Similarly, 2-week-old chicks fed a selenium deficient or supplemented diet were given an oral dose of Se^{75} and the distribution of the isotope in several tissues was determined at 24 and 168 hours after administration. Vitamin E had no effect on distribution of selenium, but selenium it-

self had a marked effect on the uptake and retention of radioselenium. One-half of the dose was retained by selenium-deficient chicks at 7 days, whereas only 1/5 of the dose was retained by chicks fed 1 ppm selenium from day-of-age. Considerable selenium was deposited and retained in the cerebellum of chicks even though this element cannot prevent encephalomalacia. (auth)

23065 CLEARANCE OF Rb^{86} FROM CORONARY BLOOD BY THE ATRIA OF DOGS. W. D. Love and L. P. O'Meallie (Tulane Univ., New Orleans and Univ. of Mississippi, Jackson). Proc. Soc. Exptl. Biol. Med., 112: 911-13 (Apr. 1963).

The rate of clearance of Rb^{86} from blood by several areas of the atria was studied in 18 dogs because of evidence that Rb^{86} uptake and rate of coronary blood flow are closely related. Mean rates of clearance averaged 0.40 ml blood/g/min. These were not significantly different in the right atrium, left atrium and interatrial septum. Rb^{86} uptake by the atria formed a larger portion of total myocardial uptake when cardiac output was low. Frequently the clearance per gram of tissue exceeded that found simultaneously in the ventricles. This indicates that atrial flow is better maintained when the animal is in poor condition than in flow to the ventricles. (auth)

23066 THE MECHANISM OF ACTION OF AET. IV. THE DISTRIBUTION AND THE CHEMICAL FORMS OF 2-MERCAPTOETHYLGUANIDINE AND BIS(2-QUANIDOETHYL) DISULFIDE IN PROTECTED MICE. Bernard Shapiro, Emanuel E. Schwartz, and George Kollmann (Albert Einstein Medical Center, Philadelphia). Radiation Res., 18: 17-30(Jan. 1963).

The distribution and chemical nature of the protective agent in the various tissues of 8- to 10-week-old C57BL/6J male mice given a protective dose of MEG-S^{35} and GED-S^{35} were studied. Results were obtained at 20 minutes after an intraperitoneal (i.p.) injection of 140 and 280 mg of MEG per kilogram and at 20, 60, and 120 min after an i.p. injection of 140 mg of GED per kilogram. Protein-bound S^{35}, GED, taurocyamine, guanidoethanesulfinic acid, MEG, and sulfate were identified in the serum, tissues, and excreta. Several unknown compounds were also observed. Concentrations of protein-bound S^{35} and GED decreased at 120 minutes after GED administration and correlated best with protection of the mice. All products increased in the tissues at the higher dose of MEG. Some differences in the concentrations of products were noted on comparison of MEG with GED-treated animals. The relation of the results to the mechanisms of action of MEG and GED is discussed. (auth)

23067 TOXICOLOGICAL STUDIES OF TRITIATED THYMIDINE. L. D. Samuels and W. E. Kisieleski (U. S. Public Health Service, Rockville, Md. and Argonne National Lab., Ill.). Radiation Res., 18: 620-32(Apr. 1963). (TID-16928)

Factors influencing the expression of radiotoxicity of tritiated thymidine in the mouse were studied, and parameters for toxicity measurement were evaluated. Uptake and retention of activity were found to be only partially related to total dose given at a single time. Dividing of doses into serial parts increased uptake and retention, whereas increasing the specific activity of TdH^3 used or increasing the age of the animal decreased uptake and retention. Several parameters for measuring radiotoxicity of TdH^3 were studied, but cytological damage to testis was found most consistently and proportionately related to exposure. It is suggested that toxicity of tritiated thymidine is best related to uptake and retention rather than to administered intraperitoneal dose, and that factors influencing uptake and retention may play an important role in expressed radiotoxicity. (auth)

23068 THE HYDRO-SALINE TURNOVER ESTIMATED WITH RADIOACTIVE ISOTOPES. I. THE SODIUM TURNOVER RATE STUDIES WITH Na^{22} IN HUMAN SUBJECTS IRRADIATED FOR THERAPEUTIC PURPOSES. Francesco Di Pietrantonj (Università, Palermo and Ospedali Galliera, Genoa). Radiol. Med., 49: 360-77(Apr. 1963). (In Italian)

Sodium-22 was used in the calculation of the sodium turnover through the various metabolic routes in urine, perspiration, and feces. The total turnover may be obtained from the body radioactivity curve and by subtracting every day the amount eliminated through urine. The urinary turnover is then estimated from the retained dose, as obtained by subtracting every day the dose eliminated through urine. These methods, applied to 18 consecutive patients showed that approximately half of the sodium renewed each day is renewed through routes other than urinary elimination. It was demonstrated that irradiation influences the elimination of sodium-22 through the urine, in the sense of a fall in said elimination, without, however, interfering with the elimination of sodium-23. This discrepancy opens the way to an original hypothesis on sodium metabolism. (auth)

23069 EFFECT OF CITRATE ON THE INCORPORATION OF ACETATE-1-C^{14} IN LIVER LIPIDS OF RABBITS. N. I. Zhuravskii (Inst. of Biochemistry, Kiev). Ukr. Biokhim. Zh., 34: 715-19(1962). (In Ukrainian)

The effect of various quantities of administered citrate on acetate incorporation in the liver lipids of normal and starved rabbits was studied in vivo. It is shown that in quantities of 10 and 20 γ per g of weight of the animal citrate increases acetate-1-C^{14} incorporation in the liver lipids; in large quantities (50 γ), it has an inhibiting effect. In experiments on normal rabbits the administered citrate intensifies acetate-1-C^{14} incorporation two to three times more than in starved animals. (auth)

23070 INFLUENCE OF VARIOUS PROTEIN DIETS ON THE INCORPORATION OF I^{131} IN THE THYROID GLAND OF THE RAT. A. Hock and H. Berger (Humboldt Universität, Berlin). Z. Ernaehrungswiss., 2: 103-8(July 1961).

Rats were fed diets containing various proteins in different amounts for 8 to 25 days. They were then fasted for 2 hr and injected intraperitoneally with 1 μC I^{131}. Four hr later thyroid protein was isolated and its activity counted. The highest I^{131} uptake values were obtained in rats fed a 30% Torula yeast diet. The uptake was only half as high in rats fed a standard diet containing 13% protein or diets containing 15% casein, legumes, or no protein at all. The uptake was 70 to 80% as high, compared with the 30% yeast diet, with diets containing 15% Torula yeast + methionine or + cystine, 15% skim milk, or 16% gelatin. I^{131} uptake showed seasonal variations, being ~40% lower from May to October than from January to February, when the Torula yeast diet was fed. The seasonal difference was less marked (20%) when the skim milk diet was used. Although no close correlation was found between the biological value of the proteins tested and their ability to stimulate thyroid I^{131} uptake, it is likely that amino acid imbalance may be responsible for the lower uptake values with some proteins. (H.H.D.)

23071 THE CATALYTIC ACTION OF THORIUM AND ZIRCONIUM IONS ON PHOSPHATE-CONTAINING SUBSTRATES OF CARBOHYDRATE METABOLISM. Heinz Trapmann and Muljibhai Devani (Universität, Munich). Z. Physiol. Chem., 326: 102-5(1961).

Th and Zr ions were shown to catalyze the dephosphorylation of phosphoric acid esters under mild, physiological conditions. Thus, at 37° over the pH range 2 to 10, these ions promote the release of inorganic phosphate from glucose-1-phosphate, glucose-6-phosphate, fructose-6-phosphate, fructose-1,6-diphosphate, and 3-phosphoglyceric acid. In the physiologic range (pH 6 to 8), Th ion was considerably more active than Zr ion. Of the substrates tested, glucose-1-phosphate was split most rapidly; in the presence of Th^{4+} at pH 7, ~ 36% was split within 24 hr. Under the same conditions, Zr^{4+} split only 7.5%. Th ion also rapidly dephosphorylated fructose-1,6-diphosphate at pH 7, whereas Zr ion was only one-third as effective. The fact that the ions break down important substrates of carbohydrate metabolism should be considered as a possible explanation of their toxicity in biological systems. (TCO)

23072 A BASIC TOXICITY CLASSIFICATION OF RADIONUCLIDES. Technical Reports Series No. 15. (International Atomic Energy Agency, Vienna). 1963 45p. $1.00; Sch 21; 6s. stg; NF 4; DM 3.20 (IAEA).

Radionuclides are classified into groups according to their toxicity. (C.H.)

Fallout and Ecology

23073 RELATIONSHIPS BETWEEN THE DEPOSITION OF STRONTIUM-90 AND THE CONTAMINATION OF MILK IN THE UNITED KINGDOM. E. R. Mercer, J. D. Burton, and B. O. Bartlett (Agricultural Research Council Radiobiological Lab., Wantage, Berks, Eng.). Nature, 198: 662-5(May 18, 1963).

The extent to which recently deposited Sr^{90}, aside from the cumulative total in the soil, is responsible for the contamination of milk was examined in U.K. on the basis of survey data from 1958 to 1961. Data are given for the estimated Sr^{90} depositions and Sr^{90} contamination of milk in England and Wales. Proportionality factors are derived for deposited and soil Sr^{90} and are compared with those for other parts of the world. (D.L.C.)

Radiation Effects on Living Tissues

23074 (AED-C-04-08) AUSGEWÄHLTES SCHRIFTTUM NACH SACHGEBIETEN. STRAHLENEINWIRKUNG AUF LEBENDES GEWEBE UND ORGANISMEN. BIBLIOGRAPHISCHE ZUSAMMENSTELLUNG. (Bibliography on Radiation Effects on Living Tissue and Organisms. Bibliographic Review of Selected Subjects). W. Stahlhofen (Max-Planck-Institut fur Biophysik, Frankfurt am Main). Dec. 10, 1962. 315p.

References (1294) are given to reports and U. S. and foreign journals published during 1960 and 1961. References are also given to NSA whenever possible. Separate author, report number, and journal indexes are included. (P.C.H.)

23075 (AED-C-04-09) AUSGEWÄHLTES SCHRIFTTUM NACH SACHGEBIETEN. STRAHLENEINWIRKUNG AUF LEBENDES GEWEBE UND ORGANISMEN. BIBLIOGRAPHISCHE ZUSAMMENSTELLUNG. (Bibliography on Radiation Effects on Living Tissue and Organisms. Bibliographic Review of Selected Subjects). W. Stahlhofen (Max-Planck-Institut fur Biophysik, Frankfurt am Main). Dec. 20, 1962. 144p.

References (515) are given to reports and books published during 1961. References are given to NSA whenever possible. Separate author, report number, and corporate author indexes are included. (P.C.H.)

23076 (BNL-6929) EFFECTS OF IRRADIATION ON THE INTESTINAL CELL POPULATION. Henry Quastler (Brookhaven National Lab., Upton. N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 15p.

The radiation syndrome that kills mice in 3.5 days was found to be mainly due to irradiation of the small intestine. Radiation injuries were defined by anatomical fractionation following irradiation first of the entire body region, then of smaller areas, and finally of surgically exposed individual organs. Irradiation with 1200 rad or more of any region that includes the entire small intestine resulted in death at precisely the same time as irradiation of the whole body. Irradiation of any major fraction of the bowel alone resulted in death under the same circumstances but at a slightly later time, and irradiation of the entire body minus the protected surgically exposed small intestine did not cause a comparable syndrome. The sequence of histological changes in the intestinal epithelium after irradiation is described and cell population kinetics in the irradiated animal is discussed. (C.H.)

23077 (LADC-5467) SERUM ENZYME CONTENT FOLLOWING X-RAY AND GAMMA-NEUTRON IRRADIATION. L. B. Cole and D. F. Petersen (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract W-7405-eng-36. 15p.

The fate of enzymes released by injured tissues into the peripheral circulation was followed in rats, rabbits, and monkeys following exposure to x radiation or gamma-neutron irradiation. Increases in serum enzyme activities ranging to 246% of the preirradiation were found, but no consistent relationship was observed between dose and magnitude. Possible factors responsible for the variability are discussed. (C.H.)

23078 (NP-12674) DOSIS GENETICAMENTE SIGNIFICATIVA DEBIDA AL USO MEDICO DE IODO 131 EN LA REPUBLICA ARGENTINA. Informe No. 76. (Genetically Significant Dose in Medical Use of Iodine-131 in the Republic of Argentina. Report No. 76). A. E. Placer, R. B. Bravo, and E. J. Silva (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1962. 21p.

A calculation was made of the genetically significant dose from the medical use of I^{131} in 1960. The results showed that the dose is of the order of 0.02 mrad/year. (J.S.R.)

23079 (NP-12760) QUARTERLY PROGRESS REPORT NO. 47 [ON RADIOBIOLOGY]. (Chicago. Univ. Air Force Radiation Lab.). Apr. 15, 1963. Contract AF 41 (609)-1693. 183p.

Separate abstracts were prepared on 11 sections of this report. (C.H.)

23080 (NP-12760(p.1-12)) INFLUENCE OF X-IRRADIATION ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF YOUNG MALE RATS. Bernard E. Hietbrink, Marjorie Keshmiri, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Studies were undertaken to determine the influence of repeated exposures of 100 or 200 r of x irradiation on the development of the phosphorothioate-oxidizing enzyme system in the livers of young male rats. It was found that the enzyme activity of the livers of rats which were given 100 or 200 r of x ray at 23 days of age and a like dose at 37 days of age reached the normal adult level at approximately the same time as the livers of animals which were irradiated at 23 days. Administration of the second dose of 100 or 200 r of x ray at 30 days of age increased the pe-

riod of radiation-induced inhibition of development of enzyme activity. The injection of 200 mgm/kgm of MEA ten minutes before 500 r of x ray failed to substantially reduce the radiation-induced inhibition of the synthesis of the drug metabolizing enzyme system in the livers of young male rats. The results of experiments on the influence of partial-body shielding indicated that the administration of 800 r of x irradiation to the liver area of 23-day old rats caused a substantial inhibition in the rate of synthesis during the 12 to 21-day period following radiation. Measurements of the influence of daily intramuscular injections of adrenal cortex extract on the radiation-induced inhibition of the development of the phosphorothioate-oxidizing enzyme system were performed. Results of these measurements indicated that daily injections of adrenal cortex extract reduced the degree of radiation-induced inhibition in the synthesis of the drug metabolizing enzymes in the livers of young male rats. (auth)

23081 (NP-12760(p.13-21)) THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION-INDUCED CHANGES IN ENZYME ACTIVITIES IN CERTAIN RAT TISSUES. Bernard E. Hietbrink, Marjorie Keshmiri, and Mary E. Hayward (Chicago. Univ. Air Force Radiation Lab.).

A study was conducted to determine the influence of 2-imino-thiazolidine-4-carboxylic acid on the radiation-induced changes in the enzyme activity of the spleens, thymus glands, and intestines of rats. It was found that administration of 140 mgm/kgm of the thiazolidine (expressed as equivalents of HCN) ten minutes before x irradiation provided 19% and 16% reductions in the biological effect of 400 r in the spleens and small intestines respectively. Administration of this compound 25 minutes before radiation provided substantial protection to the spleens but did not benefit the other tissues studied. Increasing the dose of the thiazolidine to 175 mgm/kgm failed to enhance the protective activity in the hematopoietic tissues. The combination of 140 mgm/kgm of 2-imino-thiazolidine-4-carboxylic acid and 200 mgm/kgm of MEA did not reduce the biological effect of x irradiation to the extent of MEA given singly. Experiments were undertaken to obtain information concerning the radioprotective activity of mixtures of cysteine and MEA or cysteine and AET when administered orally. These studies indicated that mixtures of 1,000 mgm/kgm of cysteine with 200 mgm/kgm or 250 mgm/kgm of MEA provided moderate reductions in the biological effect of radiation in the hematopoietic tissues but did not benefit the intestines when given 30 minutes before x ray. Doses of AET ranging from 300 mgm/kgm to 700 mgm/kgm were given in combination with 1,000 mgm/kgm of cysteine. The mixture containing 1,000 mgm/kgm of cysteine and 600 mgm/kgm of AET was the most effective and provided reductions of 37, 22, and 25% in the biological effects of x irradiation in the spleens, thymus glands, and intestines respectively. Results of studies on the effects of 140 mgm/kgm of 2-imino-thiazolidine-4-carboxylic acid on the 30-day survival of rats given 850 r of x ray showed that the administration of this agent ten minutes before radiation permitted 60% survival. One of the five rats given the thiazolidine derivative 25 minutes before radiation survived the test period. Administration of the compound 25 minutes after 850 r of x ray enhanced the lethal effects of radiation as indicated by a marked reduction of the median survival time. (auth)

23082 (NP-12760(p.22-8)) INFLUENCE OF X-IRRADIATION ON THE REDUCTASE ACTIVITY OF THE LIVERS OF PARTIALLY HEPATECTOMIZED RATS. Kenneth P. DuBois and Bernard E. Hietbrink (Chicago. Univ. Air Force Radiation Lab.).

Measurements of the reductase activity of the livers of female mice indicated that the enzyme activity was slightly lower than the activity of the livers of male mice. The enzyme activity of the livers of normal male guinea pigs was 25 to 35% of the level of activity in the livers of rats and mice. The reductase activity of the livers of partially hepatectomized male rats was measured on unirradiated rats and on comparable animals given 200 r of x irradiation 18 hours after hepatectomy. No difference was observed between the enzyme activity of the irradiated and unirradiated animals. Conduction of the reductase assay under aerobic conditions also did not reveal any differences between irradiated and control animals thus indicating that utilization of reduced triphosphopyridine nucleotide through oxidative reactions was not sufficiently inhibited by this dose of radiation to cause accumulation of reduced triphosphopyridine nucleotide. (auth)

23083 (NP-12760(p.29-53)) THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Results are presented of toxicity and radioprotective evaluation studies on thirty-four additional chemical compounds in male CF_1 mice. Eleven of these compounds were found to exhibit significant radioprotective activity in that they reduced the 30-day mortality of the x-rayed mice. The most marked effect was obtained with PD-77 which allowed 60% of the mice to survive for 30 days after an otherwise lethal x-ray exposure. Two compounds protected 40% of the mice in a similar manner. They were VI-5, a biguanide derivative of Phenformin, and PD-37. PD-35 protected 20% of the x-rayed animals against the 30-day mortality and a bunte salt, 1-(1-pyrrolidinocyclohexyl)-methyl thiosulfuric acid (UI-1), protected 17%. The rest of the compounds found to be effective in these tests produced a 30-day survival of 10% of the mice given the whole-body x ray exposure of 700 r. These compounds were: glutathione preparations, AL-1 and AL-2; Phenformin derivatives, VI-1 and VI-3; and PD-78 and PD-82. An extract of high molecular weight bacterial lipopolysaccharides was administered to mice at various times prior to a lethal dose of x ray using two different dosage levels. No protection was seen with any of the treatments used. An extract of chlorophyll was administered acutely before and after and chronically after an otherwise lethal dose of whole-body x irradiation. Premedication with this material was effective in protecting 30 and 20% of the mice for 30 days when administered at dosage levels of 10 and 100 mgm/kgm respectively. The post-treatment was effective when 10 mgm/kgm was given either immediately following the x ray exposure or when it was given chronically. Propylene glycol was given chronically for four days prior to 700 r of whole-body x irradiation and found to be protective to 40% of the mice so pretreated. Mercaptoethylamine hydrochloride, obtained from three different sources, was compared for radioprotective activity. Sixty per cent of the animals given the compound obtained from General Biochemical were protected against the lethal x ray exposure while the compound obtained from California Biochemical protected only 10% of the mice and the Eastman Kodak product exhibited no protective activity. (auth)

23084 (NP-12760(p.54-76)) THE EFFECTS OF PRE-IRRADIATION AND POST-IRRADIATION ADMINISTRATION OF CYANIDE AND OTHER COMPOUNDS ON RA-

DIATION LETHALITY IN MICE. J. Dilley and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

An optimal dose of potassium cyanide equal to 2.25 mgm/kgm of HCN and 2.50 mgm/kgm as HCN was found to afford maximum protection against higher doses of x ray in female and male CF_1 mice respectively. Higher but nonlethal doses seemed to cause diminution of the protective effect. An unpurified mixture of 2-imino-thiazolidine-4-carboxylic acid was shown to protect female CF_1 mice against lethal doses of whole-body x ray and the apparent dose reduction factor is about 1.2 based on these studies. Further studies are in progress in an effort to determine the mechanism(s) responsible for the effect. (auth)

23085 (NP-12760(p.77-91)) THE EFFECT OF CHEMICAL PROTECTION ON LIFE-SPAN SHORTENING IN X-IRRADIATED MICE. J. Doull, V. Plzak, and J. Cowan (Chicago. Univ. Air Force Radiation Lab.).

The longevity of female CF_1 mice given various chemical radioprotective agents prior to acute x-ray exposures of 400, 600, and 800 r was compared with that of non-irradiated animals given the protectors and with non-protected irradiated animals in order to determine whether any of these agents reduce or prevent the life-span shortening effects of acute x ray exposure. Pretreatment with serotonin creatine sulfate (90 mgm/kgm IP) increased the age corrected median survival time of the x rayed mice by about eight weeks but the protective effect is small in comparison with the ability of this agent to prevent acute (30-day) radiation effects. Mice pretreated with p-aminopropiophenone (30 mgm/kgm IP), 2-aminoethylisothiourea dichloride (200 mgm/kgm IP), or 2-mercaptoethylamine hydrochloride (300 mgm/kgm IP) prior to the administration of x-ray doses of 600 or 800 r exhibited age corrected median survival times comparable or less than those seen in animals given these x-ray doses without protection. All of these agents increased the median survival time of mice given 400 r of x irradiation but correction of the life-span shortening data for the increase in longevity produced by the administration of the agents alone eliminated the apparent protective effects in these animals. No evidence was obtained in the present studies that pretreatment with the radioprotective agents decreased the incidence of other delayed radiation sequelae. (auth)

23086 (NP-12760(p.92-102)) EFFECT OF VARIOUS RADIOPROTECTION TREATMENTS IN MICE. H. D. Landahl and A. T. Hasegawa (Chicago. Univ. Air Force Radiation Lab.).

Use of an external $\frac{1}{4}$ in. lead shield (0.1 × 2 × 0.7 cm) placed over the spleen of mice increased the LD_{50} for whole-body x ray exposure from about 450 to 890 r. The administration of serotonin (100 mgm/kgm intraperitoneally) in addition to the external shielding of the spleen increased the LD_{50} to about 1,075 r whereas MEA (400 mgm/kgm intraperitoneally) plus spleen shielding increased the LD_{50} to about 1,200 r. MEA alone was about as effective as spleen shielding alone. Hydroxylamine given prior to whole-body x ray exposure at a dosage level of 50 mgm/kgm results in a slight protection but increasing the dose to 200 mgm/kgm (given over a period of 15 minutes to minimize toxicity) increases the LD_{50} of whole-body x ray exposure to over 800 r giving a dose reduction factor (DRF) of close to 2. Anoxia produced by exposing mice to an environmental oxygen concentration of about 4.6% increased the LD_{50} of whole-body x ray exposure to about 1000 r. Production of anoxia within 10 seconds after x ray exposure gave no protective effect. Administration of sodium cyanide at different times prior to an x ray exposure of 700 r showed that the greatest survival occurred when the agent was given at four minutes prior to the irradiation. Experiments involving the topical application of drugs to the spleen gave the following results: substantial degrees of protection could be obtained with histamine and 2-aminoethylisothiourea but the amounts required to produce protection were comparable to the amount of each agent required to produce radioprotective effects when given intravenously. Electric shocks to the spleen failed to yield a significant protective effect. Administration of 400 mgm/kgm of MEA and 200 mgm/kgm of $NaNO_2$ before 1,300 r resulted in 30-day survivors indicating an additive protective effect. (auth)

23087 (NP-12760(p.103-34)) EARLY AND LATE RADIOPROTECTIVE EFFECTS IN PROTON-IRRADIATED MICE PRETREATED WITH CHEMICAL PROTECTORS. D. G. Oldfield, J. Doull, V. Plzak, A. Hasegawa, and A. Sandberg (Chicago. Univ. Air Force Radiation Lab.).

Previous studies of radioprotection against 440-Mev proton radiation were replicated and extended confirming the original conclusion that pre-irradiation treatments with MEA and PAPP are able to reduce 30-day mortality in CF_1 mice. A new assay parameter, survivance, defined as the time integral of the fractional number of animals surviving to a given time, is introduced and several of its properties and intended uses discussed qualitatively. Judged on the basis of the survivance at 100 days, MEA protects more effectively than PAPP against 440-Mev protons. (auth)

23088 (NP-12760(p.135-54)) GROSS AND MICROSCOPIC PATHOLOGY IN MICE GIVEN CHEMICAL RADIOPROTECTIVE AGENTS PRIOR TO IRRADIATION WITH 440 Mev PROTONS. D. Vesselinovitch, F. Fitch, D. G. Oldfield, V. Plzak, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Autopsy and histopathological findings are described in the tissues of CF, male mice given 2-mercaptomethylamine or p-aminopropiophenone prior to whole-body irradiation with 440-Mev protons or x rays. The findings indicate that differences in the pathologic effects of the two types of radiation are more quantitative than qualitative. (C.H.)

23089 (NP-12760(p.155-65)) STUDIES ON THE TOXICITY OF RARE EARTH COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY. David W. Bruce and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Intravenous administration of 20 and 30 mgm/kgm of praseodymium as the nitrate salt caused no significant decrease in the blood glucose of male rats. This is in contrast to the marked decrease in blood glucose in female rats caused by an equitoxic dose of this compound. Evidence presented in this report indicates that dietary intake of 6 to 9 grams per day of sucrose or dextrose by female rats will prevent the mortality resulting from the intravenous administration of 2 mgm/kgm of praseodymium as the nitrate salt. Dietary intake of 2 to 3 grams of dextrose or 6 to 9 grams of fructose per day was ineffective in preventing mortality. The results suggest that the mortalities are due to the decreased blood glucose. Intravenous administration of 20 mgm/kgm of praseodymium to male rats as the nitrate salt reduced the glucose-6-phosphatase activity of the liver 17 and 15% in 24 and 48 hours after administration, respectively. Four mgm/kgm of praseodymium alone or in combination with 500 r of x irradiation had no effect on the glucose-6-phosphatase activity of the liver of female rats four hours after administration. Fatty in-

filtration of the liver may account for the 18 to 25% decrease in activity found after 24 hours. A 20 and 33% increase in mortality was observed when a sublethal dose of intravenous praseodymium (1 mgm/kgm) was given 10 to 15 minutes prior to 300 and 500 r of whole body x irradiation. (auth)

23090 (NP-12760(p.166-80)) LONGEVITY IN F_1 HYBRID OFFSPRING OF IRRADIATED MICE. Ann M. Budy, John H. Rust, D. J. Mewissen, and Robert D. Boche (Chicago. Univ. Air Force Radiation Lab.).

The longevity of offspring from an irradiated and a nonirradiated parent was compared. Mice of strains dba and C-57 Black were mated and cross-mated 56 days before and 10, 120, and 180 days after 200 r whole-body x irradiation was delivered either to the male or female parent. There was a reduction in the number of successful pregnancies and in the litter size of the 120- and 180-day matings with the irradiated male parent. This reduction in pregnancies did not hold for the irradiated female parent in the 10-day mating; they were sterile in subsequent matings. The percentage of animals born and living until weaned and the distribution of sexes at weaning time did not follow a consistent pattern. Irradiation of the male parent reduced the life span of its progeny without regard to their sex whether conceived immediately after irradiation or 120 or 180 days later. It is likely that spermatozoa were irradiated in the first matings and spermatogonia in the second and third. Irradiation of the female parent did not reduce the life span of its progeny, regardless of sex. Females given 200 r whole-body x irradiation were sterile at 120 and 180 days after exposure. (auth)

23091 (TID-18031) A SURVEY OF EXPOSURES RECEIVED BY HOSPITALIZED PATIENTS DURING ROUTINE DIAGNOSTIC X-RAY PROCEDURES. Charles K. Spalding and Russell F. Cowing (New England Deaconess Hospital. Cancer Research Inst., Boston). [Feb. 25, 1963]. Contracts AT(30-1)-609 and AT(30-1)-901. 22p.

From the survey of 2605 patients that were admitted for diagnostic studies in the x ray departments of eight hospitals in the Boston area, it was found that the dosage to those under 30 years of age was considerably lower than to those between 51 to 70 years of age. The ratio of patients under 30 years of age in relation to the total patients subjected to x ray examinations was found to be less than 11 per cent. Patient dosage may be decreased by as much as 25 per cent in the average x ray department when properly trained technicians are employed and when fluoroscopic examinations are carried out by experienced radiologists. Student technicians should be closely guided by senior personnel. (auth)

23092 (TID-18625) RADIATION STUDIES ON MAMMALIAN CELLS GROWN IN A CHEMICALLY DEFINED MEDIUM. Roland M. Nardone (Catholic Univ. of America, Washington, D. C.). [1963]. Contract AT(30-1)-2564. 10p.

Studies were made on the effects of ionizing radiation on the multiplication, size, gross cytology, protein and nucleic acid synthesis, and respiration of strain L (mouse fibroblast). Cultures irradiated with 100, 300, and 500 r, after a lag phase, manifest growth curves with slopes similar to those of nonirradiated cultures. Cultures irradiated with 1000 to 2000 r increase the lag phase and depress the growth curve slopes. Doses above 2500 r result in complete mitotic arrest. Doses of 500 to 1500 r resulted in nuclear blistering and gigantism, the frequency increasing with time after irradiation. In addition to cell multiplication, growth in terms of culture volume (mass) and average cell size was studied. Forty-eight hours after irradiation the cell numbers in 500-r-exposed populations were 45% below that of controls while the culture volume was reduced 28% and the average cell size was increased 12%. Extracellular protein synthesis was more sensitive than intracellular synthesis, with inhibition in both experiments becoming more pronounced each day. Inhibition of RNA synthesis was dose and time correlated. RNA synthesis inhibition was much more sensitive than DNA synthesis in the same cells. Because of radioinduced gigantism, irradiated cells had much more protein and DNA per cell than those from nonirradiated cultures but the RNA content of giant cells was equal to that of normal cells. Warburg studies of endogenous respiration indicate that respiration inhibition is correlated with dose and duration of the post-irradiation period. (P.C.H.)

23093 (UCRL-10559) NEUTRON TISSUE DOSE AT LARGE DISTANCES FROM AN ELEVATED UNSHIELDED REACTOR. Henry Aceto, Jr., Michael A. Pick, and Lloyd D. Stephens (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 11, 1963. Contract W-7405-eng-48. 17p.

The neutron tissue dose at large distances from a fission source was studied by using a water-filled phantom and four different detectors: a BF_3 counter, a polyethylene-lined ethylene-filled proportional counter, indium foils, and nuclear emulsions. The source of fission neutrons was the ORNL Health Physics Research Reactor which was attached to a hoist which was in turn installed on a 1530-foot tower. The reactor could be operated at any elevation from 27 to 1500 ft. The phantom studies were made at horizontal distances from 250 to 1500 yards from the tower. Dose contributions from recoil protons, $H^1(n,\gamma)D^2$ and $N^{14}(n,p)C^{14}$ reactions are considered. (auth)

23094 (UR-625) RADIATION INDUCED ACUTE MYOCARDIAL INFARCTION IN THE DOG. Arthur J. Moss, Douglas W. Smith, Solomon Michaelson, Bernard F. Schreiner, and Gerald W. Murphy (Rochester, N. Y. Univ. Atomic Energy Project). Mar. 12, 1963. Contract W-7401-eng-49. 27p.

The radiation effects of 2,500 to 20,000 roentgens on the canine myocardium were studied. A collimated x-ray beam, 2.54 cm in diameter, was delivered to the heart of 12 dogs at a rate of 210 roentgens per minute. A localized area of myocardial necrosis was evident by the seventh to tenth post-irradiation day in the hearts which received a dose of 20,000 roentgens. Evolution of the myocardial lesion was documented electrocardiographically and by pathologic examination. Microscopically, the cardiac necrosis was strikingly similar to vascular infarction in the human myocardium. The use of this radiation technique for the experimental production of localized myocardial necrosis is discussed. (auth)

23095 (USNRDL-TR-634) THE EFFECT OF AGE AT EXPOSURE UPON THE RADIATION-INDUCED DENTAL DEFECT IN RATS. D. C. Jones, T. J. Castanera, and D. J. Kimeldorf (Naval Radiological Defense Lab., San Francisco). Mar. 21, 1963. 21p. (AD-403646)

Studies were made on the effect of age at irradiation upon the severity and temporal distribution of the radio-induced dental lesion. Male rats were irradiated with a high sublethal dose (215 rads) of fast neutrons at 31, 110, or 619 days of age. The typical lesion (a chalky zone extending the full width of the tooth) was observed in the exposed shafts of the incisors beginning in the second month post-irradiation. While all animals exhibited the lesion in all incisors, the character of the lesion and its

time sequence varied markedly with age at irradiation. The severity of the radiation effect was greater in the youngest group, as indicated by a wider lesion and a greater incidence of animals with fractured incisors (68% vs 11 or 12% for the older groups). The time sequence of appearance, duration of visibility, and disappearance by attrition at the occlusal edge occurred earlier in younger animals. However, the temporal differences appear related primarily to anatomic and physiologic factors associated with age per se rather than to a differential intensity of radiation damage. (P.C.H.)

23096 (AEC-tr-5795) MODIFICATIONS OF PROTEINS OF LYOPHILIZED GLUTEN TREATED BY GAMMA IRRADIATION. [PART] I. A. R. Deschreider. Translated from Biul. Central. Lab. Technol. Przetworstwa Przechowalnictwa Zboz Warszawie, 5: No. 1, 4-9(1961). 19p. (Includes original, 6p.).

Procedures and results are described of studies on the effects of γ radiation on proteins of lyophilized gluten from wheat flours. (C.H.)

23097 (AEC-tr-5797) MODIFICATIONS OF PROTEINS OF LYOPHILIZED GLUTEN TREATED BY GAMMA IRRADIATION. [PART] II. A. R. Deschreider. Translated from Biul. Infor. Central. Lab. Technol. Przetworstwa Przechowalnictwa Zboz Warszawie, 5: No. 2, 29-34(1961). 16p. (Includes original, 6p.).

Procedures and results are described of studies on the effects of γ radiation on the amino acids in gluten from wheat flours. Changes in solubility in water and alcohol induced by irradiation were found to be similar to changes accompanying the irradiation of flour. (C.H.)

23098 THE EFFECT OF X-RAY TREATMENT ON LEUKOCYTE ALKALINE PHOSPHATASE IN CANCER PATIENTS. C. Wasastjerna, B. Jeglinsky, and C. E. Nylund (Central Hospital of Vasa, Finland). Acta Med. Scand., 173: 505-10(Apr. 1963). (In English)

The leukocyte alkaline phosphatase (LAP) of venous blood was evaluated by cytochemical means. The average score in 58 cancer patients did not differ significantly from the normal value. A moderate increase was usually noted immediately after a course of x ray treatment of 3,000 r or more, but many exceptions were noted. The individual variability was much more pronounced in irradiated cancer patients than in untreated healthy people. An x ray dose of less than 3,000 r had no effect on LAP in 16 patients, nor did treatment with cyclophosphamid in the seven cases observed. (auth)

23099 STUDIES ON THE URINARY FORMALDEHYDOGENIC STEROIDS (FGS) IN ALBINO RATS UNDER VARIOUS EXPERIMENTAL CONDITIONS. 3. VARIATION OF URINARY FGS IN ALBINO RATS WITH EXPERIMENTALLY INDUCED LIVER INJURY, HYPOTHALAMIC LESION, AND TOTAL BODY IRRADIATION WITH X RAY OR Co^{60} γ RAY. Hideo Muranaka (Kyoto Univ.). Acta Schol. Med., Univ. Kioto, 37: 269-90(Mar. 1961).

Urinary levels of formaldehydogenic steroids (FGS) in rats with liver injury induced by carbon tetrachloride showed a tendency to increase in the acute stage of cirrhosis 4 to 8 weeks later and decreased slightly in the chronic stage 17 to 28 weeks later. In the late stage of cirrhosis the response of urinary FGS to ACTH injection was diminished. Rats treated with dimethylaminoazobenzene (to produce hepatomas) excreted large amounts of FGS in the intermediate stage (8 months later) and the response of urinary FGS to ACTH injection was nearly normal. Urinary FGS levels were not decreased in the course of experiment. In rats with liver injury caused by ethionine the urinary FGS level was decreased markedly at the initial stage of the experiment, and the response of urinary FGS to ACTH was barely demonstrable. This suggests that the adrenocortical activity is reduced in rats whose liver is injured by ethionine. Hypothalmic lesions in other rats generally caused a marked decrease of the urinary FGS. In rats exposed to 900-r whole-body x radiation, urinary FGS decreased gradually after the 3rd day, and increased transiently before death. Response of urinary FGS to ACTH in the rats irradiated by 900 r of x rays or Co^{60} γ rays was somewhat delayed, particularly on the 5th day after exposure. In rats irradiated with 600 r of x rays, no change of urinary FGS excretion was found, and the response of urinary FGS to ACTH was normal. In the rats irradiated by lethal dose (900 r) of γ rays, prolongation of life was effected by subcutaneous injection of 4 units of ACTH on the 2nd day after exposure. The results suggest an increased demand for adrenocortical hormone shortly after lethal irradiation. (TCO)

23100 IMMUNIZATION EXPERIMENTS WITH IRRADIATED LUNGWORM LARVAE. G. T. Edds, L. E. Swanson, and H. Engelbrecht (Univ. of Florida, Gainesville). Am. J. Vet. Res., 24: 139-42(Jan. 1963).

Samples of feces containing first-stage larvae of Dictyocaulus viviparus were incubated for 7 days, and the third-stage infective larvae were collected, cleaned, cooled, and irradiated with 40000 r. The bulk vaccine was stored in a refrigerator until determinations of potency, viability, safety, and freedom from bacteria or other parasitic contamination were conducted. Two doses of irradiated third-stage lungworm larvae were given to susceptible calves in controlled and field trials. The first dose of 1000 larvae, given when the calves were 6 to 8 weeks old, and the second dose, given when the calves were 10 to 12 weeks of age, provided sufficient immunity for the calves to withstand field challenge of average severity. When exposed to heavy challenge, vaccinated calves sometimes developed a light infection and contaminated clean pastures. Such vaccinates should be placed on infected pastures prior to the expected lungworm season. This stimulates further immunity in the vaccinates and helps to hold down the level of pasture contamination. The results were obtained in 71 field tests conducted in 12 states. (TCO)

23101 THE EFFECT OF α-PARTICLES FROM A RING-SHAPED Po^{210} SOURCE ON THE ACTION POTENTIAL OF SINGLE NERVE FIBERS OF THE FROG. R. M. Bergstroem, R. F. Blafield, and M. W. Brenner (Univ. of Helsinki). Ann. Acad. Sci. Fenniae, Ser. A V, No. 82, 10p(1961).

A method was used in which cylindrical nerve and muscle cells could be irradiated in a circumscribed manner, with heavy particles, under strictly controlled experimental conditions. This permitted irradiation of cell structures at different depths, that is, the membrane structures and deeper cytoplasmic structures. For this purpose, Po^{210} 5.3-Mev α rays were used; the depth of penetration of Po^{210} α particles into the nerve fibers was slight (up to 40 μ in water). The irradiation doses varied from 1000 to 10000 rep. The action potentials of single sciatic fibers of the frog were obtained by means of electrical stimulation. A radiation dose of 3600 rep was capable of reducing the potential amplitude during the 30-min period of observation. With the largest dose, the action potential was suppressed in a few minutes. With the smallest dose, hardly any diminution of the action potential was noted, but rather a slight increase in the potential was observed immediately after

the beginning of irradiation. The experiments show that the ionizing effect of the α particles acts on the processes of the axon responsible for the electrical behavior of the membrane. The interaction consists of an initial increase in the electrical activity of the membrane. (TCO)

23102 SELECTIVE DESTRUCTION BY HEAVY NUCLEAR IRRADIATION OF THE CELL MEMBRANE IN INTERNODAL CELLS OF NITELLOPSIS OBTUSA. R. M. Bergstroem, R. F. Blafield, and M. W. Brenner (Univ. of Helsinki). Ann. Med. Exptl. Biol. Fenniae (Helsinki), 40: Suppl. 1, 44p.(1962).

A study was made of the dose and site of action of the absorbed energy of α particles on the electrophysiologic equilibrium of the resting cell membrane of an alga, the Characean N. obtusa. The alteration in the fine structure of the cell was studied by electron microscopy. About 40 internodal cells were studied. The results indicate the existence of a polarized outer cytoplasmic membrane situated close to the inner surface of the cellulose cell wall. The membrane, assumed to be responsible for the main potential difference between the cytoplasmic non-free space and the free space of the cell wall, was depolarized after irradiation doses of 12000 rep, the potential difference being depressed 30% for 24 hr. An initial increase in the potential difference was observed with the same dosage. The study of ultrastructural changes caused by irradiation revealed that doses as small as 7000 rep are capable of producing vacuolation of the lamellar interspaces of the cell wall in regions adjacent to the cytoplasmic outer membrane (plasmalemma) and the inner border of the cell wall. With higher doses, the cytoplasm separated from the wall, and prominent vacuolation and destruction of the cytoplasmic structures occurred. It was concluded that both the initial increase and later depression of the potential difference at the cell membrane may result from impairment of the permeability of various membraneous structures in the cell. (TCO)

23103 THE EFFECT OF RADIATION ON THE PRODUCTION OF MUCIN IN SALIVARY GLANDS AND THE FEMALE GENITAL TRACT OF RODENTS. A. Glucksmann (Strangeways Research Lab., Cambridge, Eng.). Ann. N. Y. Acad. Sci., 106: 631-5(Mar. 30, 1963).

Pelvic exposure of rats and mice to doses of 300 to 400 r resulted in increased mucin secretion and suppression of keratinization. Estrogen prevented or modified keratinization suppression by radiation, depending on the timing of radiation and of estrogen administration. Similar results were obtained with vaginal cells in tissue cultures. Vitamin A also inhibited the keratinization of vaginal epithelium. The salivary glands in rats showed long-term changes in type and quantity of secretion after irradiation with doses of 850 r/day for 4 days. Radiation damaged the reproductive capacity of acinar cells and induced a compensatory secretory activity in cells of the sublingual ducts and hypertrophy of the secretory tubules of the submandibular. (C.H.)

23104 STUDIES ON THE ADRENAL AFTER GENERAL IRRADIATION BY X RAYS IN THE RAT. J. Tusques and R. Senelar (Faculté de Médecine, Nantes, France). Arch. Anat. Pathol., Semaine Hop., 9: 219-24(Aug. 1961).

Preliminary studies of the effects of ionizing radiation on the thyroid indicated that 60% of the animals developed adrenal lesions, particularly of an infarctoid type. Further studies were conducted by exposing rats to 600-r doses of x rays. Adrenal medulla and cortex were examined histologically 2 to 54 hr later. The medulla showed severe congestion, with dilated capillaries filled by red cells, but no actual hemorrhage was seen. Areas of cellular lysis, in which the nuclei were hyperchromatic and pyknotic, were also seen. Many cells showed complete loss of cytoplasm and that remaining was strongly eosinophilic. Around these areas were cells with swollen nuclei and nucleoli but with normal appearing cytoplasm. The lesions were apparent within 5 hr postirradiation. In the cortex the zona glomerulosa also showed congestion, but less pronounced than in medulla, and destruction of cells. In the zona fasciculata, entire cords of cells showed lysis and pyknotic nuclei, sometimes adjacent to intact cords of cells. The zona reticularis also showed areas of necrotic cells. It is suggested that the pattern of radiation injury, seen in the adrenal as islets of damaged cells surrounded by relatively normal looking cells, can be explained in terms of primary injury to the blood vessels. The vascular changes include swelling of endothelium, thrombosis, and hyalinization of adventitia. Thus interruption of the blood supply to microregions could account for the observed relative radiosensitivity of the adrenal. (H.H.D.)

23105 RECURRENCES OF BROCQ'S NEURODERMATITIS AND MEASUREMENT OF RADIOACTIVITY AND FALLOUT. C. M. Hasselmann and K. Schuba (Universitaetsklinik und Poliklinik fuer Haut- und Geschlechtskrankheiten, Erlangen, Ger.). Arch. Klin. Exptl. Dermatol., 212: 319-24(1961).

The possible influence of climatic and atmospheric factors, especially radioactivity, on relapses of parakeratosis psoriasiformis was investigated. Attempts were made to determine whether exacerbations occurring in spring and autumn could be correlated with variations in atmospheric radioactivity, naturally occurring and from fallout. In central Europe most of the natural atmospheric radioactivity originates from radium and its products. Measurements of α, β, and γ activity on a seasonal basis showed that all 3 curves paralleled each other, and, in most of the 59 patients with dermatitis studied for a year or longer, exacerbations of the disease closely followed peak activities. Of 42 recurrences, 76% followed a rise in atmospheric activity whereas 24% followed a fall in activity, which represents a significant difference. The possibility that ionized particles in air may aggravate the skin lesions is suggested. (H.H.D.)

23106 REVERSION OF THE EFFECTS OF RADIATION ON LYSOGENIC BACTERIA. Renana Ben-Gurion (Israel Inst. for Biological Research, Ness-Ziona). Biochem. Biophys. Res. Commun., 11: 399-403(May 28, 1963).

When two lysogenic strains of Escherichia coli were grown in minimal media, washed, and irradiated with ultraviolet light for 1 min and then diluted again into their respective minimal media, with and without added cysteine, there was a marked difference in the titer of phages produced by the irradiated bacteria when compared with non-irradiated. When the bacteria were grown before irradiation in minimal media supplemented with cysteine, the production of phage was the same whether cysteine was added after irradiation or not. Results suggest that if protein synthesis is disturbed immediately after irradiation this disturbance can reverse the process of phage induction caused by ultraviolet light. Possible reaction mechanisms involved are discussed. (C.H.)

23107 THE HERTWIG EFFECT IN TELEOST DEVELOPMENT. R. Lasher and R. Rugh (Marine Biological Lab., Woods Hole, Mass. and Columbia Univ., New York). Biol. Bull., 123: 582-8(Dec. 1962).

Mature sperm of the marine teleost Fundulus heteroclitus were exposed to Cs^{137} γ radiation at a dose rate of 5000 r/min, to total doses ranging from 5000 to 150000 r, and were then used to fertilize normal eggs of the same species. Control eggs from the same batch were inseminated with unirradiated sperm from the same source. Sperm retained motility even after 150000 r. While variations in normal fertilizability of the control eggs did occur, associated with the season and breeding activity, in every case some eggs were fertilized and developed following insemination with sperm that had been exposed to every dose level. This was not mere activation since cleavages followed. The presence of irradiated sperm chromatin had no effect on the time or nature of the early cleavages. The initial adverse effects were noted at the time of gastrulation. Exposure of sperm to 500 r had no apparent effect on the development of eggs, while exposures to 5000 r caused high mortality and morbidity, and at doses above 5000 r the effect of radiation appeared to decrease so that a greater percentage of near-normal embryos resulted from cleaving eggs. A severe abnormality common to both the 5000-r and 50000-r series was the failure of the embryo to form either a neural or body axis. The fact that a few specimens from sperm receiving 50000 r or more could not be readily distinguished from the controls suggests that complete recovery of diploidy may sometimes occur after activation. This was substantiated by cytological examination. (TCO)

23108 COMPARATIVE KILLING EFFICIENCIES FOR DECAYS OF TRITIATED COMPOUNDS INCORPORATED INTO E. COLI. Stanley Person (Pennsylvania State Univ., University Park). Biophys. J., 3: 183-7(May 1963).

The killing efficiencies due to the decay of incorporated H^3-thymidine, H^3-uridine, and H^3-histidine in E. coli 15_{T-L-} were determined. Decays from H^3-thymidine are 2.0 times as effective in producing lethality as those from H^3-uridine and 2.5 times as effective as those from H^3-histidine. Therefore, it seems that the greater part of damage from H^3-thymidine decays is due to chemical changes associated with nuclear transmutation. (auth)

23109 STUDY OF THE RADIOSENSITIVE STRUCTURE OF T2 BACTERIOPHAGE USING LOW ENERGY ELECTRON BEAMS. A. Cole and R. Langley (Univ. of Texas, Houston; and Anderson Hospital and Tumor Inst., Houston). Biophys. J., 3: 189-97(May 1963). (TID-18201)

Hydrated T2 bacteriophage was irradiated with 0.75 to 90 Kev electron beams. A thin foil isolated the sample chamber from the electron gun source. Survival (plaque formation) was observed. Apparent cross-sections and D_{37} doses were determined. The maximum cross-section of about 5×10^{-3} μ^2 is roughly equal to the cross-sectional area presented by the phage core. As beam energy was increased the average D_{37} dose first attained a minimum value of about 23 kr for 1 kev electrons (which penetrate the relatively inert protein coat) after which the average D_{37} dose rose with beam energy to a maximum value of about 50 kr for fully penetrating beams. These dependencies suggest that the radiosensitive structure exists as a peripheral shell rather than a uniformly sensitive core. A tentative model for the phage structure, based on this and other evidence, is presented. (auth)

23110 LOSS OF SOLUBLE MATERIALS FROM IRRADIATED THYMOCYTES IN VITRO. D. K. Myers, Donna E. Dewolfe, Kimiko Araki, and W. W. Arkinstall (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Biochem. and Physiol., 41: 1181-99(May 1963).

Following exposure to x radiation in doses above 100 r, rat thymocytes lose soluble compounds into the extracellular fluid during incubation in Krebs-Ringer solution at 37°C and pH 7.4. Acid-soluble ribonucleotide and potassium ion concentrations in the irradiated cells decreased markedly after an initial lag period of 1 hr, during which the irradiated thymocytes could not be distinguished from control cells. The losses were accompanied by a gradual depolymerization of deoxyribonucleic acid. At least one labile enzyme, deoxycytidylate deaminase, also became inactivated. A similar loss of nucleotides and potassium ion from the thymus gland also occurred following its irradiation in the intact animal. A decrease in pH or temperature during incubation of irradiated thymocyte suspensions minimized the loss of potassium from the cells; the same treatments were found previously to decrease the sensitivity of the cells to the lethal effects of x radiation. The loss of soluble materials appeared to be related to subsequent death of the cells. However, rapid loss of intracellular potassium from thymocytes is probably due to a breakdown of intracellular binding structures rather than to inhibition of active ion transport. (auth)

23111 UNCOUPLING OF OXIDATIVE PHOSPHORYLATION BY IONIZING RADIATION. II. THE STABILITY OF MITOCHONDRIAL LIPIDS AND CYTOCHROME c. J. F. Scaife and B. Hill (Dept. of National Defence, Ottawa). Can. J. Biochem. and Physiol., 41: 1223-33(May 1963).

Mitochondria isolated from the thymus of rats or rabbits 4 hr after 800 rads of ionizing radiation show uncoupling of their oxidative phosphorylation. There are no significant differences in the contents of phospholipids, neutral lipids, or total fatty acids between normal and uncoupled mitochondria. There was no evidence of the formation of any lipid uncoupling factor in thymus mitochondria from irradiated animals. Heart or liver mitochondria isolated from animals irradiated up to 12 hr previously showed no uncoupling of oxidative phosphorylation although preparations in various media could be made with reduced cytochrome c contents. No effect of irradiation upon endogenous cytochrome c or its binding in the mitochondria could be detected. Thymus mitochondria would appear to contain very low quantities of cytochrome c (less than 0.2 μg per mg protein), yet still be tightly coupled. It is suggested that the low level may indicate a critical condition at which radiation damage could become manifest. (auth)

23112 THE EFFECT OF CESIUM 137 RADIATION ON PLANT GROWTH AND FLOWER COLOR OF GREENHOUSE CHRYSANTHEMUM VARIETIES. G. M. Weaver (Canada Dept. of Agriculture, Harrow, Ont.). Can. J. Genet. Cytol., 5: 73-82(Mar. 1963).

Chronic exposure of pink, white, yellow and bronze color representatives of the Indianapolis Series of chrysanthemums resulted in growth stimulation at dose rates from 1.9 to 5.7 roentgens per hour. The frequency and direction of color changes following irradiation provide evidence for the genetic nature of the chimeral tissue relationship in pink, white and bronze flowers. The process of widespread natural sporting is interpreted as being the result of infrequent cell substitutions between tunica layers through periclinal divisions and substitutions between the corpus and tunica in genetically heterogeneous varieties. Radiation induced color sports may arise either through cell substitution into damaged areas as in the color changes from pink to bronze, or through mass destruction of the tunica layers in the apical meristem, as in the color changes from pink to white, yellow and cream. The second

tunica layer appears especially sensitive to radiation effects. Since this tissue is gametogenic, such effects may contribute to an unfavorable environment for the selection of useful mutations in seed propagated species. In contrast, these same effects on clonally propagated species would be useful in revealing latent internal genetic diversity. The altered chimera might then be of sufficient value as an improved variety or as a parent in further breeding. (auth)

23113 EFFECT OF A SMALL DOSE OF X RADIATION ON LOCAL RECURRENCE OF TUMORS IN RATS AND MICE. W. R. Inch and J. A. McCredie (Ontario Cancer Treatment and Research Foundation London Clinic, London and Univ. of Western Ontario, London). Cancer, 16: 595-8 (May 1963).

The incidence of local recurrence of carcinosarcoma 256 Walker in rats and a mouse tumor in mice was studied after administration of a small dose of x radiation. The mammary tumor occurring spontaneously in C3H/HeJ mice was transplanted into first generation offspring and can be considered isologous. The rat tumor was grown in the subcutaneous tissues of the back for 9 days and the mouse tumor for 30 days; excision at these times was followed by a high incidence of local recurrence. X radiation (2,000 rads) was given to the tumor 24 hours before operation or to the operative site 24 hours after excision of the growth; the same dose was given to the normal tissues of the controls on the day of operation. It was found that the preoperative radiation decreased the incidence of local recurrence of both tumors. Postoperative radiation was less effective; it decreased recurrences of the carcinosarcoma 256 Walker in the rat but only delayed the appearance of the mouse tumor. (auth)

23114 EFFECTS OF THYMECTOMY ON THE LYMPHATIC REGENERATION OF IRRADIATED MICE, RESTORED BY ISOLOGOUS FETAL LIVER. Jean-Francois Duplan (Institut du Radium, Paris). Compt. Rend., 256: 3366-8(Apr. 8, 1963). (In French)

Mice were thymectomized at the age of 40 days and irradiated 30 days later with a 100% lethal x-ray dose. If these animals are restored by cells of isologous fetal liver, they all die between 30 and 60 days after irradiation. Their lymphatic organs remain aplastic. (tr-auth)

23115 RADIATION SEQUELAE IN THE BLADDER AND URINARY TRACT IN WOMEN WITH CERVICAL CANCER AND ITS TREATMENT. K. M. Bauer (Chirurgische Universitaetsklinik, Tuebingen, Ger.). Fortschr. Med., 79: 389-92(Aug. 17, 1961).

Radioinduced injuries of the urinary tract are considered in relation to changes occurring in the bladder, ureters, and kidneys. Changes that may be observed in the bladder are: hemorrhagic cystitis with or without hematuria, bullous edema, ulceration, teleangiectasia, vesicovaginal fistula, contracted bladder, and other late occurrences such as sclerosis and incontinence. The initial inflammatory changes in bladder mucosa may be reversible but the late fibrosis is not. Conservative treatment of bladder injury consists of the use of spasmolytics, heat applications, and instillation of antibiotics into the bladder along with corticosteroids and vitamin A. Surgical intervention may be necessary to correct a fibrotic shrunken bladder or vesicovaginal fistula. The most severe complication of radiotherapy may be injury to the ureters, which may account for 10% of the fatalities resulting from cervical carcinoma. Cortisone may be used for conservative treatment, whereas surgery may be necessary to form a ureteral-intestinal fistula or a ureteral-vesical anastomosis after removal of the damaged segment. Use of plastic materials to replace the segment is described and success with various surgical technics is discussed. Primary radioinjury of the kidney is a relatively rare sequel to treatment of cervical cancer, and secondary damage from hydronephrosis and ascending pyelonephritis is much more frequent. Complications and their treatment in 103 cases are described. (H.H.D.)

23116 ENDOTOXIN-INDUCED TOLERANCE TO TOXIC MANIFESTATIONS OF CANDIDA ALBICANS. H. F. Hasenclever and William O. Mitchell (National Inst. of Allergy and Infectious Diseases, Bethesda, Md.). J. Bacteriol., 85: 1088-93(May 1963).

Mice exposed to 425 r total-body irradiation failed to become tolerant to Candida albicans toxicity after injection with lipopolysaccharide. Mice injected with lipopolysaccharide and then x rayed did not demonstrate the tolerant state. An injection of thorium dioxide in mice that had previously received tolerance-inducing amounts of lipopolysaccharide rendered them as susceptible to acute C. albicans toxicity as control mice. A bimodal manifestation of tolerance was noted. Groups of mice given single injections of lipopolysaccharide at 6 or 1 days before challenge demonstrated high levels of tolerance, whereas the tolerance in mice given a single dose at 3 days was negligible. The bimodal effect was not observed in tolerant mice challenged with lipopolysaccharide. Injections of viable or nonviable pathogenic fungi known to produce tolerance to the toxicity of C. albicans in recipient mice did not produce tolerance to lipopolysaccharide. Serum from mice injected with lipopolysaccharide showed in vitro inhibitory activity for C. albicans. (auth)

23117 ANTIBODY FORMATION INITIATED IN VITRO. II. ANTIBODY SYNTHESIS IN X-IRRADIATED RECIPIENTS OF DIFFUSION CHAMBERS CONTAINING NUCLEIC ACID DERIVED FROM MACROPHAGES INCUBATED WITH ANTIGEN. M. Fishman and F. L. Adler (Public Health Research Inst., New York). J. Exptl. Med., 117: 595-602 (Apr. 1, 1963).

A system was utilized in which lymph node cells from nonimmunized rats were stimulated to produce specific antibody. The stimulus was provided by a cell-free homogenate of peritoneal exudate cells, consisting mainly of macrophages, which had been incubated with antigen (T2 phage). Treatment with ribonuclease (RNase) rendered the system ineffective, indicating that nucleic acid was an essential factor. Tests for activity of the purified material were conducted with the aid of diffusion chambers. Activity was measured by titrating the serums of the irradiated recipient rats for specific antibody. The activity of the cell-free homogenate was retained in its RNA fraction isolated by means of the phenol method, and no antibody formation occurred if such RNA was treated with RNase. In sucrose gradients (5 to 20%), the active RNA was found to be present in the top third layer. The data confirm the critical role of macrophage RNA, showing that the capacity to initiate antibody formation resides in purified RNA from specifically stimulated macrophages. As indicated by gradient centrifugation, the RNA appears to be of low molecular weight. Preliminary data show it to be nondialyzable and phosphorylated. Studies of such RNA prepared from macrophages, which had been labeled with tritiated cytidine, show it to be readily incorporated by lymph node cells maintained in tissue culture. (TCO)

23118 CHROMOSOMAL PATTERNS OF IRRADIATED LEUKEMIC AND NONLEUKEMIC C57BL/6J MICE.

Charles F. Nadler (Northwestern Univ., Chicago). J. Natl. Cancer Inst., 30: 923-31(May 1963).

Chromosomes of 17 C57BL/6J mice receiving 600 r total-body x irradiation were analyzed and compared to chromosomes of 6 normal mice. Seven mice developed leukemia and 10 did not. Chromosomes of 4 leukemic mice were examined. Mouse #1 (generalized leukemia) had cells with a mode of 40, variation above the mode, and a large marker chromosome. Mouse #2 (localized thymic leukemia) had 2 hyperdiploid modes of 41 and 42 in thymic tissue, but normal chromosomes were in the spleen and marrow. Mouse #3 (generalized leukemia) had modes of 40 and 41 in the thymus, spleen, and marrow. Mouse #4 (localized thymic leukemia) had a modal number of 41 with variation about the mode. One of the 10 irradiated nonleukemic mice had some cells with a pseudodiploid karyotype containing a minute chromosome, and another had a questionable abnormality consisting of increased variation about the mode. The remaining 8 mice had normal chromosomes. Aneuploidy in irradiated nonleukemic mice may be due to preleukemia or to persistent x-ray induced aberrations. The possibility of persistent chromosomal alterations after x ray suggests irradiation leukemias are not ideal for evaluation of the significance of aneuploidy in mouse preleukemia or leukemia. (auth)

23119 REACTION OF THE BLOOD SYSTEM IN DOGS TO HEAVY BLOOD LOSS IN REMOTE PERIODS FOLLOWING CHRONIC IRRADIATION. L. V. Bogatov. Med. Radiol., 8: No. 2, 28-35(Feb. 1963). (In Russian)

Investigations were carried out in 3 groups of dogs: 18 months after external gamma irradiation, 10 r/day, total dose—1,300 r; after 4-fold plutonium administration, 0.05 microcurie/kg for a period of 4 months; and 4 yr after external gamma irradiation, 18 r/day, total dose—954 r. In all three groups a reaction of the blood system to acute blood loss (33 to 39% of blood) took place, the same as in nonirradiated dogs. Peripheral blood restoration occurred at the same time or even earlier than in controls. In contrast to controls, the blood regeneration in experimental animals occurred against the background of marked hyperplasia of the red series, while in animals of the first group posthemorrhagic reticulocytosis was absent. (auth)

23120 ON CHANGES OF THE "PAIN LEUKOCYTIC REACTION" IN RADIATION AND COMBINED RADIATION INJURIES. M. I. Ulyanov and B. V. Sakharov (Central Inst. of Traumatology and Orthopedics, Ministry of Public Health, USSR). Med. Radiol., 8: No. 2, 42-6(Feb. 1963). (In Russian)

The leukocytic reaction of the peripheral blood occurring in response to weak pain irritation due to the technique of blood taking (puncture of the vein) in dogs was investigated. The reaction was termed pain leukocytic reaction. Changes in the reaction were not specific only for radiation injury; the reaction was observed during anesthesia insulin shock. Notwithstanding the nonspecific nature of the pain leukocytic reaction, it is believed that its investigation may serve as a method of simple diagnosis of radiation and combined radiation injuries. (auth)

23121 CHARACTERISTICS OF ACTUAL RADIOACTIVE CONTAMINATIONS. Stefan Kossakowski. Med. Weterynar. (Poland), 19: 2-7(Jan. 1963).

Natural and artificial radiation, the significance of studies on natural adaptive tolerance of living matter to it, and the obligatory contribution of veterinary science to this knowledge in the field of plant (feed) and animal data are discussed. (34 references.) (auth)

23122 THE PROBLEM OF PRESERVING ANIMAL FOOD PRODUCTS BY MEANS OF IONIC IRRADIATION. Jan Galuszka (Wojewodztwo Office of Veterinary Hygiene, Katowice, Poland). Med. Weterynar. (Poland), 19: 84-7 (Feb. 1963).

Results are summarized from studies on the effects of radiation processing on the wholesomeness and storage life of meat and meat products. (C.H.)

23123 CHEMICAL PROTECTION AGAINST RADIATION INJURY (STUDIES WITH VITAMIN E). Hedi Fritz-Niggli (Kantonsspital, Zurich). Muench. Med. Wochschr., 103: 2191-4(Nov. 10, 1961).

The mechanism of action of various types of radioprotective agents is discussed, and new data concerning the effect of vitamin E on irradiated mice are presented. Six hypotheses for the action of protective agents are considered: binding of free radicals; formation of radioresistant disulfides; reactivation of inhibited enzyme systems; alteration of physiologic components and morphologic structures to a radioresistant state; alteration of intra- and intermolecular energy transport systems; and physicochemical protection against radiation-conditioned structural changes. It was concluded that no single hypothesis accounts for the observed facts. The effect of vitamin E-supplemented and -deficient diets on the response of mice to x rays was tested. Mice were fed 10 mg α-tocopherol acetate daily for 5 days or a vitamin E-free diet for 21 days before whole-body irradiation with 800 r. Vitamin E supplementation did not confer protection on the mice and deficiency appeared to slightly reduce resistance to radiation. The results suggest either that the inhibition of oxidative phosphorylation is not primarily involved in the lethal effect of radiation or that vitamin E is not essential to this process. (TCO)

23124 X-IRRADIATION SENSITIVITY OF NITROGEN MUSTARD-RESISTANT MAMMALIAN CELLS IN VITRO. A. G. Lewis (Universita, Padua). Nature, 198: 498-9 (May 4, 1963).

The effects of nitrogen mustard on a guinea pig cell strain in tissue culture were compared with the effects of x radiation on similar cells. A resistant colony was isolated from the survivors of the nitrogen-mustard treated cells. No evidence was found for a cross-resistance phenomenon between x rays and nitrogen mustard with regard to survival of these cells. (C.H.)

23125 VARIATION OF RADIATION SENSITIVITY OF PARAMECIUM AURELIA AS A FUNCTION OF TIME OF IRRADIATION IN THE INTERDIVISION GROWTH CYCLE. John Calkins (Univ. of Texas, Houston). Nature, 198: 704(May 18, 1963).

Synchronized populations of P. aurelia were irradiated with ultraviolet or x rays at various stages in their interdivision cycle. The survival results were analyzed to determine the LD_{50}. The x-irradiated animals showed almost constant radiation resistance through the whole cycle, while the ultraviolet-irradiated animals were most sensitive shortly after division and thereafter gradually became more resistant. (D.L.C.)

23126 ACUTE BRAIN DAMAGE INDUCED BY LOW DOSAGE X-IRRADIATION. Robert H. Brownson, Daniel B. Suter, and Duane A. Diller (Medical Coll. of Virginia, Richmond). Neurology, 13: 181-91(Mar. 1963).

Rats which received limited head x irradiation between 500 and 10,000 r demonstrated, within one week following exposure, a decrease in activity, anorexia, and weight loss. Routine histologic analysis of neurons revealed significant alterations only in the granule cells of the cere-

bellum. These cells demonstrated increasing pyknosis and shrinkage with increasing doses. A preliminary examination indicated that this alteration is reversible. Special histologic methods for glia revealed acute swelling of oligodendroglia leading apparently to necrosis reached a maximum six to twenty-four hours after irradiation. The total numbers of altered oligodendrocytes per animal appeared directly related to the total dosage of x ray given. Significant numbers of these cells were recorded in the brains of rats receiving as few as 150 r. Morphologic alterations are described. (auth)

23127 MODIFICATION OF THE CAPACITY OF BACTERIA TO SYNTHESIZE DEOXYRIBONUCLEIC ACID FOLLOWING X RADIATION: AN IN VIVO AND IN VITRO STUDY. Daniel Billen (Univ. of Texas, Houston). Pathol. Biol., Semaine Hop., 9: 758-80(Apr. 1961).

Protein-synthesis inhibition brought about by chloramphenicol (CAP) exposure of Escherichia coli strain 15_T- subsequently increased the sensitivity of the DNA-synthesizing mechanism to x-ray damage. Whereas the synthesis of DNA was only partially inhibited when log phase cells, exposed to 10000-r x irradiation, were reincubated in a minimal-salts, glucose-thymine medium, the preincubation of the log phase cells with CAP before exposure led to a 100% inhibition of DNA replication by 10000 r. To further substantiate this finding that prior interference with protein synthesis sensitized the DNA-synthesizing mechanism, use was made of a strain of E. coli, strain 15_T-(555-7), requiring tryptophan, methionine, and arginine in addition to thymine. Protein synthesis was prevented in such cells when they were incubated in an amino acid-free medium, but when reincubated in a complete medium, DNA synthesis resumed at an increasing rate following an initial lag. The resumption of DNA synthesis could be prevented by the addition of CAP to the complete medium. Exposure of the starved cells to 10000 or 20000 r brought about a similar inhibition of resumption of DNA synthesizing activity, in a response almost identical in pattern to that illustrated for untreated E. coli strain 15_T-. Thus, interference with protein synthesis led to the apparent exhaustion of a protein (and possibly RNA) that was necessary for resumption of DNA-synthesizing activity. X-ray exposure or CAP prevented the recovery or replacement of the protein activity. Next a study was undertaken on DNA polymerase and thymidine kinase activity in extracts obtained from cells following the various treatments. Extracts obtained from E. coli strain 15_T-(555-7) exposed to 40000 r were only slightly less active in incorporating H^3-thymidine into DNA than control extracts, and exposure of control extract to 40000 r was only partially inhibitory. This indicates that destruction of thymidine-phosphorylating enzymes or DNA polymerase cannot account for the complete suppression of DNA synthesis observed in vivo. In addition, it was shown that pretreatment either by starvation or CAP does not lead to gross depletion of polymerase or thymidine kinase activity although as much as a 50% reduction in H^3-thymidine incorporation activity was sometimes seen in such extracts. (TCO)

23128 CHROMOSOME BREAKAGE AND NUCLEAR INJURIES AS CAUSES OF DEATH OF CELLS EXPOSED TO IONIZING RADIATIONS. A. Howard (Mount Vernon Hospital, Northwood, Middx, Eng.). Pathol. Biol., Semaine Hop., 9: 835-8(Apr. 1961).

Nuclear sensitivity of cells was demonstrated by experiments in which cells were partially irradiated, from nuclear transfer experiments, from the relation between radiation dose and number of chromosome breaks induced, and from observations on multinucleate cells. Chromosome breaks resulting from exposure of cells to ionizing radiations, or to a variety of chemicals, can be detected only in cells that divide after the breaks are induced. Other kinds of nuclear effects (interruption, postponement, or slowing down of DNA synthesis, mitotic delay, nuclear enlargement, pycnosis) can be seen in the absence of division. Although it is not known to what extent the effects may be causally related to each other or to the induction of chromosome breaks, breakage of chromosomes per se does not appear to be a cause of cell death. It is apparent that genetic loss due to chromosome breakage is an important, but not the only, cause of cell death following irradiation. (TCO)

23129 PEROXIDE FORMATION IN PLANT CELL AFTER IONIZING RADIATION EFFECT. E. V. Budnitskaya (Inst. of Biochemistry, Moscow). Pathol. Biol., Semaine Hop., 9: 844-5(Apr. 1961).

Biochemical changes were investigated in bean and barley seedlings after exposure to 1000 to 20,000 r x irradiation. Lipoxidase, an enzyme oxidizing unsaturated fatty acids, increased 30 to 50% within 24 hr after irradiation. Four hr after 20,000 r, the unsaturated fatty acid content of bean seedlings fell sharply, and lipid peroxide values rose markedly after 1000 to 10,000 r. Most of the lipid peroxide was present in the free lipid fraction of irradiated seedlings; very little bound lipid peroxide was present after irradiation. Since lipid peroxides have been shown to be cytotoxic and to inhibit mitosis in vitro, inhibit enzyme systems, and depolymerize DNA, part of the injurious effect of irradiation on the cell may be thus explained. Peroxidase activity could be destroyed by steaming the seedlings. When such steamed leaves were irradiated with 10,000 r, no lipid peroxides were formed, indicating their formation in unheated leaves results from the action of the enzyme. The changes in cellular lipids following irradiation may be related to postirradiation changes observed in cell membranes, mitochondria, microsomes, and nuclei. (H.H.D.)

23130 SERIAL TRANSFER OF ISOLOGOUS AND HOMOLOGOUS HEMATOPOIETIC CELLS IN IRRADIATED HOSTS. D. W. Van Bekkum and W. W. H. Weyzen (Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk, Netherlands). Pathol. Biol., Semaine Hop., 9: 888-93(Apr. 1961).

Isologous bone marrow and spleen cells were serially transplanted into x-irradiated (800 r) mice using various intervals and cell numbers. The degree of repopulation was estimated at each successive passage by counting the cells in suspensions prepared from femurs and spleens. With CBA males, 10^6 bone marrow cells were injected to establish the first passage. Seven days after transplantation the bone marrow was found to be partially regenerated and 1.3×10^6 of the cells were injected into irradiated second passage hosts. The second passage mice possessed only a very small number of cells per femur on day 7 and 1.1×10^6 cells/femur on day 14. The restorative capacity was low, which resulted in failure to establish the 3rd passage. When the interval between passages was kept at about 14 days and the number of injected cells between 4.4 and 8.6×10^6, the line was carried successfully through 4 passages. The results suggest that the proliferation rate of the more primitive cell types is higher than that of the more mature ones, leading to a gradual shift in favor of the former when serial transfer is performed at short intervals. Longer intervals permit more time for maturation to take place. The favorable effect of increasing the periods between passages

was shown by the results obtained with intervals of 21 to 48 days in an isologous CBA cell line. Up to 13 passages could thus be obtained with a mixture of 9 to 17 × 10^6 spleen and marrow cells. C57BL cells were transferred through 4 passages of F_1(CBA × C57BL) hybrid mice. The results, obtained with a variety of experimental techniques, are suggestive of the development of a specific tolerance of the transferred cells toward the CBA tissue antigen. (TCO)

23131 ON THE MECHANISM OF CELL DESTRUCTION IN HEMATOPOIETIC ORGANS UNDER THE EFFECT OF IONIZING RADIATION. N. F. Barakina (Inst. of Animal Morphology, Moscow). Pathol. Biol., Semaine Hop., 9: 902-4(Apr. 1961).

Mouse bone marrow and spleen (whole organs or fragments) were x irradiated with 700 to 5000 r and incubated in physiologic solution for 4 hr at 37°C. In some experiments the organs from whole-body irradiated (700, 1000, 5000 r) mice were incubated and examined. In contrast to the evident injury of cells of irradiated intact animals, no destruction of cell elements in hematopoietic organs took place if cell elements were irradiated in vitro or if they were removed immediately after irradiation. However, bone marrow cells exposed in vitro to 700 r completely lost their ability to restore hematopoiesis in irradiated animals. No destructive changes were found in spleen cells if the spleen was surgically isolated or if its nerves and vessels were ligated 5 to 10 min after exposure of the animal to 1000 r. Removal of the ligature 1 to 3 hr later invariably led to the development of typical destructive processes in the organ. Cell suspensions irradiated with 1000 r in vitro and injected immediately after exposure directly into the spleen of unirradiated mice underwent destruction. The results indicate that radiosensitivity of cells of hematopoietic organs does not differ markedly in vivo and in vitro and that the destruction of hematopoietic elements may be interpreted in terms of direct radiation damage. (TCO)

23132 EXPERIMENTAL STUDIES ON BLOOD VESSEL CHANGES IN THE IRRADIATED KIDNEY. L. Bianchi (Kantonsspital, St. Gallen, Switzerland). Pathol. Microbiol., 24: 270-5(1961). (In German)

Injury of the human kidney is described in 60 cases that received radiation doses of 2000 to 6850 r, and was seen clinically as albuminuria, edema, and terminal uremia, and sometimes hypertension. Histologically, lesions in the glomeruli and blood vessels were most severe, and resulted in secondary changes in the tubules and interstitial fibrosis. Vascular necrosis was most prominent in the arterioles and small arteries. To clarify the course of radioinduced renal lesions, their pathogenesis was studied in the rat and rabbit. As in man, hypertension could be induced in the rat by renal radiation, but in rabbits, unlike the case in rats, tubular changes were severe, as was the resulting interstitial fibrosis. Rat glomerulus appeared to be more radioresistant and remained intact despite severe tubular lesions. Arterioles and small arteries also appeared to be more resistant but in a few instances radiation seemed to have an atherogenic effect in the vessels. Renal vessels in both rat and rabbit appear to be less sensitive to radiation than in man; their injury in man probably accounts for the hypertension that sometimes follows renal irradiation. (H.H.D.)

23133 THE EFFECT OF IONISING RADIATION ON STORED BLOOD. A. A. Sokolov (Moscow State Univ.). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 186-9(1961).

Investigations on the effects of γ radiation on stored blood showed that blood stored for short periods of time after exposure to doses up to 9500 r can be used for transfusion. The phagocytic index and number of active leukocytes in stored irradiated and control blood decreased rapidly. (C.H.)

23134 COMPARISON OF EFFECTS OF DEUTERIUM OXIDE AND X-RAY IRRADIATION ON MULTIPLICATION OF POLIOVIRUS. David Kritchevsky, Lionel A. Manson, Richard W. Hartzell, Jr., and Richard I. Carp (Wistar Inst. of Anatomy and Biology, Philadelphia). Proc. Soc. Exptl. Biol. Med., 112: 93-6(Jan. 1963).

An attenuated strain of poliomyelitis virus (CHAT) will not grow in monkey kidney cells at 40°C. When deuterium oxide (25 to 40%) is present in the medium, replication of CHAT virus will take place at 40°C. Since both deuterium oxide treatment and irradiation with x rays yield giant cells, the 2 treatments have been compared for their ability to support the growth of CHAT poliovirus at 40°C. At several levels of x irradiation, monkey kidney cells will not support the growth of CHAT virus at 40°C. When D_2O is added to the medium of the x-irradiated cells at 40°C, replication of CHAT virus is observed. The effect is not due to cell size or number. (auth)

23135 MODIFICATION OF IRRADIATION EFFECTS THROUGH ACTIVELY ACQUIRED TOLERANCE TO HOMOLOGOUS BONE MARROW GRAFTS. Don H. Shaw and Halvor Vermund (Univ. of Wisconsin, Madison). Proc. Soc. Exptl. Biol. Med., 112: 212-16(Jan. 1963).

Host and donor pigeons made immunologically tolerant in various combinations by skin grafting shortly after hatching were exposed to lethal doses of irradiation at the age of 8 to 10 months. Homologous bone marrow transplants showed that the tolerant state of the host did not appreciably affect survival and tolerance of marrow donors for host increased mean survival by about 10 days. These data suggest that the immunologic mechanism of the donor is more important than that of the host in producing homologous disease in the pigeon. (auth)

23136 RECOVERY OF CENTRAL NERVOUS SYSTEM FUNCTIONS IMPAIRED BY LETHAL HEAD X-IRRADIATION. V. Nair, H. Sugano, and L. J. Rogh (Univ. of Chicago). Proc. Soc. Exptl. Biol. Med., 112: 273-7 (Feb. 1963).

The effects of x irradiation on the response to maximal electroshock and on EEG were studied in head irradiated rats at various intervals following irradiation. A single application of 10,000 r to head of rats was found to induce a progressive increase in protection against maximal electroshock. This apparent anti-convulsant effect reached a maximum by about 48 hours post-irradiation and was then rapidly lost. Most of the animals died by the 7th or 8th day following irradiation. It is of interest that the irradiated animals progressively recover their ability to respond to maximal electroshock after the 48 hour period in spite of their otherwise increasing moribund state. EEG records following irradiation also suggest a similar recovery effect. These findings are interpreted as indicating that there is a progressive recovery of certain central nervous system functions impaired by a lethal dose of x irradiation. (auth)

23137 EFFECT OF IRRADIATION AND TEST SYSTEM ON DEVELOPMENT OF TETANUS ANTIBODIES. Abram S. Benenson, James N. Shively, and Stefano Vivona (Walter Reed Army Inst. of Research, Washington, D. C.). Proc. Soc. Exptl. Biol. Med., 112: 527-31(Mar. 1963).

Whole-body irradiation of dogs immunized with an alum precipitated tetanus toxoid results in a delay in appearance

of antitoxin if the first toxoid is administered after radiation. Dogs irradiated 30 days after a first dose of toxoid and receiving a booster injection 24 hours after irradiation presented a good antitoxin response when measured by the hemagglutination test. However, a poor antibody response was found if the antitoxin was measured by the toxin neutralization techniques. (auth)

23138 EFFECT OF X-RAYS ON CULTURED MONKEY KIDNEY CELLS INFECTED WITH A MYXOVIRUS. G. D. Hsiung (Yale Univ., New Haven). Proc. Soc. Exptl. Biol. Med., 112: 732-5(Mar. 1963).

Rhesus monkey kidney cells were found to be capable of forming a uniform monolayer even though they were highly infected with DA, a myxovirus. Irradiation did not result in readily observable CPE in virus infected cultures, although examination of stained preparations revealed definite changes as compared with control cultures. Increased numbers of multinucleated giant cells were observed in infected cultures exposed to x rays, whereas considerably fewer and only mononucleated giant cells were obtained in irradiated cells without virus infection. (auth)

23139 ROLE OF THE THYMUS IN RECOVERY OF THE IMMUNE MECHANISM IN THE IRRADIATED ADULT MOUSE. J. F. A. P. Miller, Sheila M. A. Doak, and A. Marjorie Cross (Royal Cancer Hospital, London). Proc. Soc. Exptl. Biol. Med., 112: 785-92(Mar. 1963).

Inbred mice were thymectomized at 2 months of age, given lethal doses of irradiation, and syngeneic marrow therapy. Controls were either sham-thymectomized and irradiated or sham-irradiated and thymectomized. Thymectomized irradiated mice failed to reject allogeneic skin grafts and to produce either a primary or a secondary immune response to sheep erythrocytes when tested 4 to 10 weeks after irradiation. At that time, control mice had normal immune functions. Lymphocytes were markedly diminished in the experimental and the thymectomized control groups. They were present and within normal limits in sham-thymectomized irradiated controls. The depression in the thymectomized irradiated mice characteristically involved the small mononuclear cells. It is concluded that recovery of the immune mechanism following total-body irradiation takes place by means of a thymus-dependent mechanism. (auth)

23140 RADIATION TECHNIQUE FOR PRODUCTION OF LOCALIZED MYOCARDIAL NECROSIS IN THE INTACT DOG. Arthur J. Moss, Douglas W. Smith, Solomon Michaelson, and Bernard F. Schreiner, Jr. (Univ. of Rochester, N. Y.). Proc. Soc. Exptl. Biol. Med., 112: 903-5(Apr. 1963).

The radiation effects of 2,500 to 20,000 roentgens on the canine myocardium were studied. A collimated x ray beam, 2.54 cm in diameter, was delivered to the heart of 12 dogs at a rate of 210 roentgens per minute. A localized area of myocardial necrosis was evident by the 7th to 10th post-irradiation day in the hearts which received a dose of 20,000 roentgens. Evolution of the myocardial lesion was documented electrocardiographically, and by pathologic examination. Microscopically, the cardiac necrosis was strikingly similar to vascular infarction in the human myocardium. The use of this radiation technique for experimental production of localized myocardial necrosis is discussed. (auth)

23141 CYTOLOGICAL EFFECTS OBSERVED IN PLANT MATERIAL GROWN ON IRRADIATED FRUIT JUICES. V. L. Chopra, A. T. Natarajan, and M. S. Swaminathan (Indian Agricultural Research Inst., New Delhi). Radiation Botany, 3: 1-6(Jan.-Mar. 1963).

Germinating seeds of barley and onion were treated for different durations with fruit juices (orange and apple) irradiated with 200,000 rad of γ-rays, a dose suggested for the pasteurization of juices. One treatment, lasting 24 hr, was split into three fractions each lasting 8 hr given on consecutive days. Controls involving treatment for identical duration with unirradiated juices were kept in all cases. Mitosis was studied in root tips fixed 24 hr after the end of the treatment. The pH and total peroxide values of the juices were determined immediately before and after irradiation. Mitosis was normal in root tips treated with unirradiated juices, only two cells in about 1000 studied containing one break each. In treatments with irradiated juices, on the other hand, varying numbers of chromosome breaks, ranging from 1 to 15 per cell, were found. Fractionation of the 24 hr treatment led to an increase in the yield of chromosome aberrations. Growth of roots and shoots was stimulated in the 4 hr treatment and retarded in the 24 hr treatment. There was a slight decrease in the pH value and an increase in the peroxide content of irradiated juices. About 20 per cent of the chromosome breaks occurred at the region of the centromere resulting in both equal and unequal distribution of the centromeric chromomeres. The rarity of chromatid aberrations suggested that the first part of interphase may be the most sensitive period to the action of irradiated fruit juices. Since it is difficult to think of an effect caused by ionizing radiations in the meristematic cells of plants which do not have a close analogue among the responses of mammalian tissues, the radiomimetic properties of irradiated fruit juices deserve consideration with regard to the assessment of the wholesomeness of fruit juices pasteurized by irradiation. Studies on the effects of storage of irradiated juices on the expression of radiomimetic effects would, however, be needed before the practical implications of this study can be determined. (auth)

23142 THE INFLUENCE OF PARAMAGNETIC IONS ON THE RADIATION SENSITIVITY OF PLANT SEEDS. Yuko Hazama, K. Hazama, and L. Ehrenberg (Stockholm Univ.). Radiation Botany, 3: 7-18(Jan.-Mar. 1963).

Barley seeds were soaked in solutions of paramagnetic ions and irradiated with γ-rays after desiccating back to low water contents. The modification of the radiation sensitivity produced by the paramagnetic ions was measured by the difference in the reduction of seedling height, or induced sterility, between treatments with paramagnetic and similar diamagnetic ions. In dry seeds, paramagnetic ions demonstrated a protective action under one atmosphere of air, but in some cases, e.g., at a high water content, in the absence of oxygen, or under a high oxygen pressure, this protection could not be detected. These facts demonstrated that paramagnetic ions exerted their protective action at a very early stage of events, possibly through a quenching of excited triplet states. (auth)

23143 RADIOSENSITIVITY OF SEEDS. III. EFFECTS OF PRE-IRRADIATION HUMIDITY AND GAMMA-RAY DOSE ON SEEDS FROM FIVE BOTANICAL FAMILIES. T. S. Osborne, A. O. Lunden, and M. J. Constantin (UT-AEC Agricultural Research Lab., Tenn.). Radiation Botany, 3: 19-28(Jan.-Mar. 1963).

Seeds of Brassica napus L. (Cruciferae), Festuca elatior L. (Gramineae), Lactuca sativa L. (Compositae), Lycopersicon esculentum Mill. (Solanaceae), and Trifolium incarnatum L. var. elatius Gibelli & Belli (Leguminosae) were equilibrated at relative humidities of 10, 35, 60, and 85 per cent then exposed to gamma-ray doses of 0, 10, 20, 40, 80, 160, or 400 Kr at 450 r/min. Seedlings were grown

for 14 to 16 days in a controlled environment and assayed for dry weight. Data were analyzed by a full-quadratic regression model. Except for Festuca, growth from irradiated and control seeds was drastically affected by pre-irradiation humidity, with higher humidities generally more damaging than lower but with growth decreasing both above and below an optimum humidity. Optimum humidity varied with species, ranging from 9 to 38 per cent R. H. in the controls, and with radiation treatment, ranging from 42 to 53 per cent R. H. at the highest doses tolerated. The hypothesis of persisting radiation-induced radicals at lower humidities does not explain the similar increase in radiosensitivity at humidities above the optimum. (auth)

23144 RADIATION GENETICS IN WHEAT. VIII. THE RBE OF HEAVY PARTICLES FROM B^{10} (N,α) Li^7 REACTION FOR CYTOGENETIC EFFECTS IN EINKORN WHEAT. Seiji Matsumura, Sohei Kondo, and Tomoo Mabuchi (National Inst. of Genetics, Misima, Japan). Radiation Botany, 3: 29-40(Jan.-Mar. 1963).

The relative biological effectiveness (RBE) of α plus Li^7 recoil particles relative to gamma-rays has been studied for seedling height depression, chromosome aberrations, and chlorophyll mutations in Einkorn wheat. Irradiation with these heavy particles was administered by using the reaction of B^{10} (n,α) Li^7; wheat seeds, which had been previously soaked in aqueous solution at different borax concentrations (0 to 1.0 per cent), were exposed to thermal neutrons in a reactor. Subtracting the radiobiological effects of thermal neutrons for seeds soaked in pure water from those found for seeds soaked in borax solution, the net effects of the heavy particles were estimated and compared with the gamma-ray effects for seeds under the same soaking conditions as for neutron treatments. The RBE values obtained for chromosome aberrations in pollen mother cells and for chlorophyll mutations were 23 ± 10 and 29 ± 10, respectively. These figures are of the same order as those for fast neutrons previously reported for wheat and barley. Most of the present results are explicable on the assumption that chromosome breakage in wheat requires many ionizations to occur within a chromosome and that the majority of radiation-induced chlorophyll mutations result not from point mutations but from chromosome breakage events. (auth)

23145 AN EARLY STAGE IN THE PLANT RECOLONIZATION OF A NUCLEAR TARGET AREA. W. H. Rickard and L. M. Shields (General Electric Co., Richland, Wash.). Radiation Botany, 3: 41-4(Jan.-Mar. 1963).

Vegetational analyses were conducted three years post-detonation in a nuclear target area in a Grayia spinosa–Lycium andersonii community in Yucca Flat, Nevada. Annual plants dominated the early stage of recolonization and were quantitatively more abundant in the disturbed areas than in an adjacent undisturbed shrub community. Mentzelia albicaulis and Chaenactis steviodes occurred in both disturbed and undisturbed areas, however; Mentzelia was more abundant in disturbed areas while Chaenactis was more abundant in the undisturbed community. Salsola kali was confined to disturbed areas while Phacelia vallis-mortae was more often encountered in the undisturbed community. The plant recolonization of a mechanically disturbed area was quantitatively and qualitatively more like that of the interior zone of the nuclear target area than less disturbed habitats. These data support a conclusion that soil displacement presents a more rigorous habitat for plant recolonization than disturbances created by the wider ranging destructive components of a nuclear detonation. (auth)

23146 THE QUIESCENT CENTRE IN ROOT MERISTEMS OF VICIA FABA AND ITS BEHAVIOUR AFTER ACUTE X-IRRADIATION AND CHRONIC GAMMA IRRADIATION. F. A. L. Clowes and E. J. Hall (Oxford Univ.). Radiation Botany, 3: 45-53(Jan.-Mar. 1963).

Rates of mitosis in four regions of the meristem of Vicia faba were determined by accumulating metaphases in normal and irradiated roots. In normal roots there is a quiescent centre with cells dividing an average of once every 200–300 hr. The stelar cells divide about once every 30 hr and the cap initials a little more slowly. Three days after receiving an acute dose of 360 rad the duration of the mitotic cycle (T) lengthens to 95 hr in the stele immediately above the quiescent centre, to 40 hr in the stele at 250μ from the pole, and to 95 hr in the cap initials. At the same time T falls to 65 hr in the quiescent centre and reaches a minimum of 38 hr at seven days after irradiation. By this time the other regions have begun to recover their normal rates of mitosis. After fourteen days of continuous irradiation at 2.28 rad/hr values of T are similar to those found shortly after acute irradiation; that is, rates of mitosis are more uniform than in normal meristems. These changes in rates of mitosis are discussed in relation to the growth rates of the roots and the reorganization of the meristem. (auth)

23147 THE EFFECTS OF X-IRRADIATION ON SEEDLING TUMOR PRODUCTION IN NICOTIANA SPECIES AND HYBRIDS. M. R. Ahuja and D. R. Cameron (Univ. of California, Berkeley). Radiation Botany, 3: 55-7(Jan.-Mar. 1963).

Germinated seedlings of several Nicotiana species hybrids differed in their response to x ray treatment. In two hybrids, N. debneyi × N. longiflora where the entire F_1 progeny was tumorous, and N. glauca × N. longiflora which had a variable incidence of tumors, 2000 r of x rays raised the seedling tumor frequency considerably. No tumors were observed in parental species following irradiation. (auth)

23148 THE RADIOPROTECTIVE EFFECT OF CYSTEINE, AET AND CYSTAMINE ON CHROMOSOME DAMAGE IN ALLIUM CEPA ROOT TIPS. H. Dalen and R. Oftebro (Inst. for Cancer Research, Oslo). Radiation Botany, 3: 59-65(Jan.-Mar. 1963).

The ability of 5×10^{-2}M cysteine, 5×10^{-3}M AET (S, 2-aminoethylisothiouronium bromide hydrobromide), and 2.5×10^{-2} M cystamine (all solutions at pH 6.5) to protect Allium cepa root tips against x ray induced chromosome aberrations was examined by scorings in anaphase 6, 12, 18, 24, 48, 72, and 120 hr after irradiation with 150, 300, and 600 r. It was found that cysteine as well as AET had some protective effect, while cystamine was inactive. Cysteine led to a more pronounced reduction (53 per cent) of chromosome damage than did AET (35 per cent). (auth)

23149 CHEMICAL PROTECTION AGAINST THE EFFECTS OF ALPHA-RAYS AND OF THERMAL NEUTRONS IN PLANT CELLS BY PRE- AND POST-TREATMENTS. R. Biebl and W. Url (Universität, Vienna and Inst. of Biology and Agriculture, Seibersdorf Reactor Center, Austria). Radiation Botany, 3: 67-73(Jan.-Mar. 1963).

Cells of the outer-epidermis of scales of the red onion (Allium cepa) were used to investigate the protective effects of various chemical substances in pre- and post-treatment against the action of alpha-rays and thermal neutrons. Thioacetamide, thiourea, methylthiourea, AET (S-β-aminoethylisothiouronium bromide hydrobromide), and MAT (methylallylisothiourea) afforded protection in pretreatment and when they were present during irradiation. The protective effect is limited in time, usually de-

creasing rapidly after the third to fourth days after irradiation. Hypotonic concentrations of glucose, fructose, saccharose, but also of $CaCl_2^+$ and KCl afforded a protective effect by post-treatment only, i.e., by the immersion of the irradiated epidermis slices in the solutions concerned. Different mechanisms are thought to be responsible for the protective effects of pretreatment on the one hand, and post-treatment on the other hand. (auth)

23150 IONIZING RADIATION AND PACKAGING EFFECTS ON RESPIRATORY BEHAVIOR, FUNGAL GROWTH, AND STORAGE-LIFE OF PEACHES, PRUNUS PERSICA. A. S. Dhaliwal and D. K. Salunkhe (Utah State Univ., Logan). Radiation Botany, 3: 75-83(Jan.-Mar. 1963).

Investigations were conducted in 1960 to study effects of fast electron and gamma radiations and packaging films on respiratory rate, control of fungal deterioration, and subsequent refrigeration life of peaches. The fungi responsible for deterioration of peaches were also studied in vitro to determine if they were susceptible or resistant to ionizing (fast electron and gamma) radiations. Respiratory behavior of the fruits under normal as well as modified conditions was assessed with a Claypool and Keefer-type respirometer and Orsat-type gas analyzer. Two kinds of polyethylene films were used for packaging fruits. The fruits after treatments and packaging were stored at 40°F and 85 per cent relative humidity and at 75°F and 35 per cent relative humidity. (auth)

23151 PROTEIN SYNTHESIS, GLYCOLYSIS, AND OXYGEN UPTAKE IN HEPATOMA CELLS IRRADIATED IN VITRO. Piero Cammarano (Università, Milan). Radiation Res., 18: 1-11(Jan. 1963).

Cell suspensions of the Yoshida ascites hepatoma were irradiated in air with increasing x-ray doses (10 to 100 kr). Aerobic and anaerobic glycolysis, oxygen uptake, and incorporation of C^{14}-leucine into protein were measured immediately thereafter. Definite inhibitions of both the glycolysis and the glycolysis-related incorporation were observed. The oxygen uptake as well as the incorporation related to the oxidative metabolism remained unimpaired. Evidence was presented that a linear reduction of glycolysis is paralleled by an exponential reduction of amino acid incorporation. Although the aerobic glycolysis was markedly depressed by x rays, the Crabtree effect was not reversed. (auth)

23152 CONTINUOUS IRRADIATION OF THE RAT AT HIGH DOSE RATES: A STUDY OF JEJUNAL DAMAGE, RECOVERY, AND RADIORESISTANCE USING TRITIATED THYMIDINE. M. R. Quastel (Royal Cancer Hospital, London). Radiation Res., 18: 46-57(Jan. 1963).

A study was made of the response of the intestinal epithelium of the rat to continuous irradiation at 415 rads/day. A steady or near-steady state was shown to develop with crypt cells taking up increased quantities of thymidine. The jejunal epithelium appeared to become more radioresistant to an acute dose of irradiation. When rats were removed from continuous irradiation, the villi soon returned to normal length, whereas the crypt mitotic counts increased considerably within 1 day. The crypt cells continued to take up increased quantities of thymidine. Intravenous isologous marrow, if given to continuously irradiated rats, will reduce the likelihood of a hemorrhagic type of death if administered after not more than 5 days total irradiation at the above dose rate. (P.C.H.)

23153 MODIFICATION OF IRRADIATION EFFECTS ON RAT EMBRYOS BY UTERINE VASCULAR CLAMPING. Robert L. Brent, John B. Franklin, and Booker T. Bolden (Jefferson Medical Coll., Philadelphia). Radiation Res., 18: 58-64(Jan. 1963). (TID-16133)

Uterine vascular clamping of the pregnant rat uterus for 45 minutes protects against the lethal and growth-retarding effects of irradiation on the eighth day of gestation and against the lethal, growth-retarding, and probably teratogenic effects of irradiation on the ninth day of gestation. If the clamping procedure is continued for more than an hour on the eighth and ninth days, it results in a high incidence of malformations. The most likely basis for the protective effect of the clamping procedure is the resultant hypoxia, but the definitive answer is not yet available. The inability of irradiation to induce malformations in the 8-day 0-hour-old rat embryo was confirmed. The discrepancy between the teratogenic action of vascular clamping and irradiation on the eighth day is presented and discussed. (auth)

23154 THE USE OF ELONGATE MICROBEAMS OF X-RAYS FOR SIMULATING THE EFFECTS OF COSMIC RAYS ON TISSUES: A STUDY OF WOUND HEALING AND HAIR FOLLICLE REGENERATION. William E. Straile and Herman B. Chase (Brown Univ., Providence and N. Y. State Dept. of Health, Springville). Radiation Res., 18: 65-75(Jan. 1963).

In a comparative biological study, mice were irradiated with a microbeam of x rays, 150 microns wide, and with a control macrobeam, 5 mm in diameter. At 9 days after irradiation, the microlesions contained visibly damaged hair follicles, which were neither hypertrophied nor hyperplastic. After 18 days of healing, the surviving hair follicles in the microlesions were thin, disorganized columns of epithelial cells. In contrast, many surviving hair follicles in the large irradiated areas were hypertrophied and hyperplastic, and they often contained keratogenous cysts. The divergent results suggest that the healing of microlesions is unusually rapid and differs qualitatively from that observed in large lesions. The possible reasons for the differences are discussed in relation to the problems of radiation damage caused by heavy cosmic-ray primaries, grid irradiation, and interface effects at the borders of large irradiated areas. The results indicate that the entire healing process should be studied separately in large and small lesions so that qualitative as well as quantitative differences in injury and repair can be properly evaluated. (P.C.H.)

23155 INDUCTION OF INTESTINAL CARCINOMA IN THE RAT BY X-IRRADIATION OF THE SMALL INTESTINE. James W. Osborne, Donald P. Nicholson, and Kedar N. Prasad (Univ. of Iowa, Iowa City). Radiation Res., 18: 76-85(Jan. 1963).

The exteriorized ileum and jejunum of male Holtzman rats were x irradiated with doses from 1000 to 2500 r. The superior mesenteric artery and vein were clamped during radiation exposure in about half of the irradiated animals. Thirty-day survival and appearance of intestinal tumors in the 12 months post-irradiation were noted. Per cent survival at 30 days was increased by the blood restriction procedure in all cases where there was some mortality due to irradiation alone. Over 50% of the irradiated animals that survived exposure doses above 1400 r because of the clamping procedure developed intestinal tumors. Radiation alone induced the neoplasm in only the 1400-r group. Tumors appeared as early as 55 days and as late as 225 days postirradiation. Animals without surgery or irradiation and those subjected to the intestinal vessel clamping procedure alone did not develop tumors. The neoplasm has features of adenocarcinoma including invasion of submucosal and muscle

layers of the gut, but the possibility that the apparent invasion of fibrous tissue by epithelium is due to trapping of epithelium still exists in some animals. Glandular epithelium in the diaphragm of one rat with an intestinal tumor and apparent neoplastic glands in the gut mesentery of another was found. There is little, if any, doubt that these represent metastases. It was not possible to transplant the tumor into normal animals. (auth)

23156 EARLY REPAIR PROCESSES IN MARROW CELLS IRRADIATED AND PROLIFERATING IN VIVO. J. E. Till and E. A. McCulloch (Univ. of Toronto and Ontario Cancer Inst., Toronto). Radiation Res., 18: 96-105 (Jan. 1963).

Early repair of sublethal radiation damage was demonstrated in surviving spleen-colonizing cells in vivo by means of dose-fractionation experiments. A study of the kinetics of the early repair process indicated that early repair reached an initial maximum at about 5 hours after the first dose fraction, followed by an intermediate minimum at about 11 hours. An assay procedure that may be used for the study of the behavior of spleen-colonizing cells in situ was developed. (auth)

23157 EFFECTS OF DIFFERENT IONIZING RADIATIONS ON HUMAN CELLS IN TISSUE CULTURE. III. EXPERIMENTS WITH CYCLOTRON-ACCELERATED ALPHA-PARTICLES AND DEUTERONS. G. W. Barendsen (TNO, Rijswijk, Netherlands), H. M. D. Walter, J. F. Fowler, and D. K. Bewley. Radiation Res., 18: 106-19(Jan. 1963).

Experiments are described in which cells of human origin in tissue culture were irradiated with α-particles of 5.2, 8.3, and 26.8-Mev energy (LET 85.8, 60.8, and 24.6 kev/μ of tissue, respectively) and with deuterons of 3.5, 6.3, and 14.9-Mev energy (LET 17.4, 11.0, and 5.6 kev/μ of tissue, respectively). Damage to the reproductive capacity was measured by counting the fraction of cells that developed into clones of more than 50 cells after irradiation. With densely ionizing particles an exponential dose-survival was obtained, whereas with sparsely ionizing radiation a partly exponential, partly cumulative type of curve was obtained. The RBE as a function of LET was determined for various levels of damage. The implications of the results are discussed. (auth)

23158 THE INFLUENCE OF IRRADIATED BASIC PROTEINS ON THE LIGHT-SCATTERING PROPERTIES OF THE NUCLEIC ACIDS. A STUDY OF INTERMOLECULAR RADIATION EFFECTS. John W. Preiss (Univ. of Delaware, Newark). Radiation Res., 18: 121-32(Feb. 1963).

Experiments were designed to determine the transmolecular boundary effects of high-energy events produced by 7-Kev electrons in dried protein layers. A plot of the excess turbidity, produced by irradiated proteins when they are added to nucleic acid solutions, as a function of dose, has a vanishing derivative at a particular dose value for each protein. When two such proteins are bombarded as components of the same dried layer, the positions and shapes of these maxima are always altered. This was shown to be a consequence of the proximity during bombardment. Such interactions are not necessarily due to what is usually called an energy-transfer process. (auth)

23159 INFLUENCE OF HISTAMINE AND CYSTEAMINE ON EXCRETION OF NITROGEN COMPOUNDS IN SPLEEN ISOLATED FROM IRRADIATED GUINEA PIG. Alenka Dekleva-Likar (J. Stefan Inst., Ljubljana, Yugoslavia). Radiation Res., 18: 133-6(Feb. 1963).

The excretion of nitrogen from perfused spleen removed from irradiated and nonirradiated guinea pigs was investigated. It was concluded that cysteamine injected immediately before irradiation reduced the excretion of nitrogen from the isolated spleen. The protective effect of histamine given prior to irradiation was less obvious than that of cysteamine, at concentrations of the two substances that were used. (C.H.)

23160 SECONDARY PROCESSES IN PROTEINS IRRADIATED IN THE DRY STATE. Thormod Henriksen, Tore Sanner, and Alexander Pihl (Norsk Hydro's Inst. for Cancer Research, Montebello, Oslo). Radiation Res., 18: 147-62 (Feb. 1963).

The secondary processes occurring in proteins irradiated with x rays in the dry state were followed by electron spin resonance (ESR) spectroscopy. The formation of sulfur radicals was given particular attention. The crystalline proteins were irradiated in vacuum at 77°K, and the spectra were recorded at this temperature after stepwise heat-treatment at successively increasing temperatures. At 77°K uncharacteristic resonance patterns were observed, reflecting the existence of several kinds of ESR center, with no sign of sulfur resonance. On heat treatment the characteristic glycylglycine pattern and/or sulfur pattern found after irradiation of proteins at room temperature appeared. When the samples were heat-treated, the total number of spins first decreased and subsequently increased significantly. The formation of sulfur radicals, which appears at slightly below room temperature, coincides with the increase in the total number of radicals. Quantitative studies on a number of proteins indicated that the extent of sulfur resonance formed at room temperature depends on the ratio cysteine-cystine/glycine. Experiments on modified proteins (thiolated gelatin) demonstrated that more sulfur resonance was formed when the sulfur was present as sulfhydryl groups than when in the disulfide form. The radical yield for proteins was of the same order of magnitude as that for a number of amino acids. Heat-denaturation of proteins in solution did not significantly alter the yields, in contrast to the findings of previous authors. The radical yields at 295°K were consistently higher than when the substances were irradiated at 77°K and subsequently annealed to 295°K. It is suggested that free radicals induced in proteins are in part formed by homolytic rupture of chemical bonds and that unpaired spins are transferred to specific structures partly by intermolecular processes. (auth)

23161 TRANSFER OF RADIATION-INDUCED UNPAIRED SPINS FROM PROTEINS TO SULFUR COMPOUNDS. Thormod Henriksen, Tore Sanner, and Alexander Pihl (Norsk Hydro's Inst. for Cancer Research, Montebello, Oslo). Radiation Res., 18: 163-76(Feb. 1963).

The interaction between crystalline proteins and small molecular thiols and disulfides irradiated in the dry state was studied by ESR spectroscopy. The substances were irradiated at 77°K, singly and in mixtures, and the samples were subsequently subjected to stepwise controlled heat-treatment. At 77°K the radical yield of irradiated mixtures of proteins with sulfur compounds was equal to weighted average of those observed when the two components were irradiated separately. When the irradiated mixtures were heat-treated, sulfur radicals were formed to a far greater extent than would be expected on the assumption that no interaction occurs between the components. Since sulfur radicals in penicillamine can be distinguished from those induced in proteins, it could be demonstrated that unpaired spins, initially induced in the protein, became transferred to the sulfur of the penicillamine. Experiments with S^{35}-

labeled cysteamine demonstrated that a small number of cysteamine residues became covalently bonded to the protein during the freeze-drying process. The ESR results on such modified proteins were indistinguishable from those obtained on the unmodified proteins, indicating that in the mixtures the transfer of unpaired spins occurs almost exclusively to sulfur compounds which were not covalently bonded. The mechanisms underlying the observed migration of unpaired spins are discussed. (auth)

23162 EFFECTS OF ATROPINE SULFATE ON THE CONDITIONED AVERSION TO SACCHARIN FLUID WITH X-RAYS AS THE UNCONDITIONED STIMULUS. James C. Smith and Dale D. Morris (Florida State Univ., Tallahassee). Radiation Res., 18: 186-90(Feb. 1963).

Conditioned aversion to saccharin in rats was obtained by using a single pairing of saccharin solution and x ray exposure. It was found that subcutaneous injections of atropine sulfate have no effect on conditioning aversion. An inverse relation was found between dose level and saccharin score in those animals receiving saccharin as the conditioned stimulus. (auth)

23163 PARTIAL-BODY X-RAY EXPOSURE AND THE DEVELOPMENT OF PROGRESSIVE INTERCAPILLARY GLOMERULOSCLEROSIS IN THE BALB/c MOUSE. Paul H. Guttman and Henry I. Kohn (Univ. of California, San Francisco). Radiation Res., 18: 191-9(Feb. 1963).

BALB/c mice were subjected to whole- or partial-body x ray (250-kv) exposure at 58 to 93 days of age. After sacrifice about 500 days later, their kidneys were examined microscopically and were graded for intercapillary glomerulosclerosis (IGS), a naturally occurring aging process, accelerated by irradiation. The results lead to the conclusion that it is the absorbed dose of radiation in each kidney itself that determines the acceleration in the development of IGS in that organ. The high x ray dose (750 and 900 rads) which was possible under conditions of partial-body irradiation resulted in more severe glomerular lesions than previously observed and in the appearance of early renal arteriosclerosis in association with the most advanced degrees of IGS. (auth)

23164 MOLECULAR RADIOBIOLOGY OF HUMAN CELL LINES. IV. VARIATION IN ULTRAVIOLET LIGHT AND X-RAY SENSITIVITY DURING THE DIVISION CYCLE. R. L. Erikson and W. Szybalski (Univ. of Wisconsin, Madison). Radiation Res., 18: 200-12(Feb. 1963).

Cell division in a human cell culture was partially synchronized by temporary inhibition of thymidylic acid synthesis. The x ray and ultraviolet sensitivities of such synchronized cells were found to vary during the replication cycle according to a specific pattern. The period of greatest radioresistance follows immediately the completion of DNA synthesis, preceding cell division. 5-Bromodeoxyuridine incorporated into DNA radiosensitizes the cells to a degree independent of the stage in the division cycle. (auth)

23165 ANTIBODY RESPONSES AFTER INJECTION OF AQUEOUS AND EMULSIFIED INFLUENZA VIRUS VACCINES IN MICE CHRONICALLY EXPOSED TO GAMMA RAYS. Byron S. Berlin (Univ. of Michigan, Ann Arbor). Radiation Res., 18: 223-30(Feb. 1963).

Hemagglutination-inhibiting (HI) antibody levels induced by aqueous and emulsified influenza virus vaccines (PR8 strain) were compared in mice continuously exposed to γ-rays. Irradiation was begun either 1 day or 8 months before vaccination and was continued until the animals were sacrificed. In mice first exposed to γ-rays 1 day before vaccination, emulsified vaccine induced significantly higher HI levels at 21 and 42 days than those obtained after injection of aqueous vaccine. In mice first exposed to γ-rays 8 months before vaccination, emulsified vaccine induced slightly better responses than those obtained with aqueous vaccine even though the long period of prevaccination irradiation markedly inhibited antibody production. Chronic administration of mercaptoethylamine by an oral route did not protect antibody-forming tissues against chronic γ-irradiation. (auth)

23166 QUANTITATIVE STUDIES OF RELATIONSHIPS BETWEEN TUMOR CELL PLOIDY AND DOSE RESPONSE TO IONIZING RADIATION IN VIVO. MODIFICATION OF RADIATION RESPONSE IN A PREVIOUSLY IRRADIATED TUMOR. Roger J. Berry (National Cancer Inst., Bethesda, Md.). Radiation Res., 18: 236-45(Feb. 1963).

A difference in dose response to x rays and Co^{60} γ-radiation was demonstrated in vivo between two closely related murine lymphocytic leukemias, one diploid and the other tetraploid. Dose-response curves were determined under oxygenated and anoxic conditions; in either condition the slopes of the dose-response curves were similar, but the extrapolation number for the tetraploid tumor exceeded that for the diploid tumor by a factor of approximately 2. A tumor line of diploid origin was subjected to 1000 rads of x irradiation at each of fifty sequential passages in vivo with 10^6 tumor cells transplanted at each passage to minimize the chance of selection from small numbers of surviving cells. During the fifty irradiated passages, this tumor line was noted to have altered radiation response with a greater proportion of tumor cells surviving any given radiation dose, increased nucleic acid content per cell was seen, and tetraploid and aneuploid cells appeared in the population. The application of these findings to the acquired radioresistance reported by radiotherapists in the treatment of human cancer is discussed. (auth)

23167 IMMEDIATE RETINAL RESPONSE TO X-RAYS AT MILLIROENTGEN LEVELS. C. S. Bachofer and S. Esperance Wittry (Univ. of Notre Dame, Ind. and Coll. of St. Catherine, St. Paul). Radiation Res., 18: 246-54 (Feb. 1963).

The retina of the grass frog, Rana pipiens, responds immediately to flashes of x rays by producing an electroretinogram. The threshold for this response is approximately 7 mr per flash. Flashes of lower intensity may produce responses, but these are of doubtful validity. A distinction should be made between the response to x rays and the damage caused by exposure to x rays. It is possible to expose the retina to hundreds of flashes of x rays with out impairment of the response, provided the interval between flashes is of sufficient duration that the retina may completely recover. Approximately 1 minute is sufficient for complete recovery. When the retina is stimulated at rapid rates, for example, one every 2 seconds, all properties of the electroretinogram, such as amplitude, rate of rise, latent period, and duration, undergo immediate modifications, but on cessation of this rapid stimulation the retina regains its ability to produce an undistorted electroretinogram in approximately 10 minutes even though doses as high as 6000 r have been delivered in this fashion. (auth)

23168 ENERGY PER ION PAIR FOR CHARGED PARTICLES IN GASES. G. N. Whyte (Queen's Univ., Kingston, Ont.). Radiation Res., 18: 265-71(Mar. 1963).

Experimental values of the average energy expended by electrons and α-particles per ion pair produced in a variety

of gases are summarized, and mean values are derived from them. Variations with particle energy are examined, and values for protons are discussed briefly. (auth)

23169 INFLUENCE OF TEMPERATURE ON THE RADIATION RESPONSE OF MAMMALIAN CELLS IN TISSUE CULTURE. James A. Belli and Frederick J. Bonte (Univ. of Texas, Dallas). Radiation Res., 18: 272-6(Mar. 1963).

Mammalian cells in tissue culture were irradiated at 5°C, 37°C, or 40°C. Cells irradiated at 5°C demonstrate radioresistance compared to cells irradiated at 40°C by a factor of 1.59. It is suggested that low temperature results in protection rather than enhances recovery. The nature of this protection is not known but it is thought to be associated closely with slowed rate processes and recombination of molecules in the metionic state before deleterious reactions can take place. (auth)

23170 PITUITARY FOLLICLE-STIMULATING HORMONE AND LUTEINIZING HORMONE AFTER TOTAL-BODY X-IRRADIATION IN THE RAT. R. T. Binhammer and I. Herman (Univ. of Cincinnati). Radiation Res., 18: 277-85(Mar. 1963).

Total-body irradiation of 40- to 50-day-old male and female rats did not alter pituitary levels of FSH or LH at 1, 6, and 24 hours after exposure, as reflected in the appropriate organ weights of hypophysectomized weanlings used as assay animals. In order to investigate pituitary gonadotropins at longer intervals after exposure, lethally irradiated, bone marrow-protected animals were studied at 30, 60, and 90 days after exposure. Testes and ventral prostates of lethally irradiated, bone marrow-protected animals were significantly decreased in weight as compared with controls. Pituitaries were increased in weight in irradiated animals 30 and 60 days after exposure and contained increased quantities of FSH at 30, 60, and 90 days but had normal amounts of LH. (auth)

23171 COMPARATIVE EFFECTS OF NEUTRONS AND X-RAYS ON MAMMALIAN CELLS. D. O. Schneider and G. F. Whitmore (Ontario Cancer Inst., Toronto). Radiation Res., 18: 286-306(Mar. 1963).

Fast neutrons and 280-Kvp x-rays were used to irradiate four types of mammalian cell. The effects studied were the loss of proliferative capacity, the inhibition of mitosis, and the production of mitotic abnormalities. A concept of relative biological efficiency was defined and used to compare these three effects. The results agree with the view that the mechanism which produces the loss of proliferative capacity is chromosomal in nature. They also suggest that the radiation damage which causes mitotic inhibition may not be the same as the damage which leads to the loss of the ability of a cell to proliferate indefinitely. Preliminary results indicate that the recovery phenomenon present after x irradiation is not present after neutron irradiation. (auth)

23172 ACUTE RADIATION EFFECTS ON SYNAPTIC ACTIVITY IN THE MAMMALIAN SPINAL CORD. Makoto Sato, Walter Stahl, and George Austin (Univ. of Oregon, Portland). Radiation Res., 18: 307-20(Mar. 1963).

A monosynaptic test reflex was studied in the spinal cord of the cat after local exposures to 0.6 to 12 Kr of x rays. Records were obtained from S_1 ventral roots and with intra- or extracellular electrodes. The facilitatory and inhibitory effects of conditioning shocks given at the L_7 and L_6 dorsal roots on the test reflex in the S_1 segment were analyzed by changing time intervals between conditioning and test shocks. Immediately after exposure to 3 Kr the facilitation observed with a latency shorter than 1.0 msec was strongly enhanced. However, with longer latencies the normal facilitation was converted into depression. Larger doses (10 to 12 Kr) resulted in less short-latency facilitation, but the response was still larger than in controls. Control preparations showed no inhibition with latencies shorter than 0.8 msec. However, after a dose of 3 Kr inhibitory conditioning shocks with very short latencies produced a marked facilitation. This paradoxical effect gradually diminishes with higher radiation doses. On the other hand, inhibitory effects with latencies longer than 1.5 msec appear to be entirely unchanged even with doses of 12 Kr. It is suggested that the enhancement of short-latency facilitation and the paradoxical facilitation are due to direct stimulatory actions of radiation on excitatory synapses. However, inhibitory synaptic activity is not directly affected by doses of 0.6 to 12 Kr. Polysynaptic reflex activity increases with higher x ray doses and may remain enhanced for several months. This increased activity is thought to be due to an integrated direct effect of radiation on individual excitatory synapses. By means of microelectrode techniques, excitatory, and inhibitory postsynaptic potentials (EPSP and IPSP) were obtained from within single motoneurons. Immediately after exposure to 600 r both polysynaptic and monosynaptic EPSP's are appreciably enhanced. With larger doses the polysynaptic EPSP appears to be increased even more than the monosynaptic EPSP. Under these conditions the prolonged IPSP is gradually masked by the EPSP as total dose becomes greater. These results are discussed. (auth)

23173 EXPERIMENTAL DETERMINATION OF THE ABSORBED DOSE FROM X-RAYS IN TISSUE. W. Gross, R. Catolla-Cavalcanti, W. B. Bell, and A. G. Fox (Columbia Univ., New York). Radiation Res., 18: 326-47(Mar. 1963).

Absorbed dose from x rays in tissue is generally obtained by calculation from the measured exposure dose. A direct measurement of absorbed dose can be obtained by the use of a tissue-equivalent plastic chamber filled with tissue-equivalent gas. A method for testing the suitability of plastics for this purpose employing a standard chamber filled with gas mixtures has been developed. The chamber was also used to determine the absorbed dose in several tissue compositions per unit of exposure dose for x rays ranging from 30 Kv to 210 Kv. Comparison is made to calculated and other experimental values. (auth)

23174 AGE AT EXPOSURE AND THE LATE EFFECTS OF X-RAYS. SURVIVAL AND TUMOR INCIDENCE IN CAF_1 MICE IRRADIATED AT 1 TO 2 YEARS OF AGE. Henry I. Kohn and Paul H. Guttman (Univ. of California, San Francisco). Radiation Res., 18: 348-73(Mar. 1963).

A study was made of the effects of age at exposure, during adult life, on the late effects of irradiation. Survival and tumor incidence at autopsy were studied in the adult CAF_1 mouse irradiated at 1, 1.5, and 2 years of age. This range was extended by reanalyzing data of previous experiments with CAF_1 mice at 5 months of age and with BALB/c mice irradiated at 5 months, 1.2, and 1.4 years of age. Since the median life span of these mice is about 2.4 years, the ages at exposure, in so far as such a comparison can be made, bracket a period equivalent to that of about 18 to 65 years in man. The present results were compared in detail with the few relevant ones in the literature for other strains of mice. In general, irradiation of old adults tended to have less life-shortening effect than irradiation of young adults, although the difference was not the same in the several strains, owing to genetic or constitutional differences. Sex was also shown to be an important factor in CAF_1 and other mice. It appeared that during much of adult

life the female reacted as if sensitized to low doses but late in life the CAF_1 female may become less sensitive than the male. These effects were correlated with changes in endocrine balance secondary to ovarian damage that would not be expected to occur in women. Life shortening was not associated with increased neoplasia in older CAF_1 and BALB/c mice, as is often the case when young animals are irradiated, but with a decrease. In the CAF_1, irradiation tended to reduce the number of decedents with tumors rather than to reduce the number of tumors per tumor-bearing decedent, and the tumorous animal lived as long or longer than the non-tumorous one. The simple concept of premature aging does not approximate a satisfactory explanation of the present results, or those of related experiments. The irradiated mouse is not one that has suddenly been aged at the time of exposure or one whose pattern of aging is normal but proceeding at an accelerated rate. The irradiated mouse is in certain specific respects an abnormal mouse and also one that is aging in an abnormal way. Usually, but not necessarily, it dies sooner than usual, depending in part on age at exposure and sex, as well as on radiation dose. The application in principle to man of some of these results with mice is probably justified. It appears reasonable to propose that the hazard of inducing late effects in man is reduced when irradiation occurs in the latter part of life and when the dose is relatively small. (auth)

23175 PERSISTENT CHROMOSOME ABERRATIONS IN IRRADIATED HUMAN SUBJECTS. II. THREE AND ONE-HALF YEAR INVESTIGATION. M. A. Bender and P. C. Gooch (Oak Ridge National Lab., Tenn.). Radiation Res., 18: 389-96(Mar. 1963).

The frequencies of chromosomal abnormalities in the peripheral leukocytes of eight men exposed to mixed gamma and fission neutron irradiation in 1958 were reinvestigated. The samples were obtained for the present study approximately 42 months after the accident occurred, whereas the earlier study was made of material collected at approximately 29 months. The men continue to show chromosomal aberrations, both gross, such as dicentric chromosomes, and minor, such as are detected only by karyotype analysis. The frequency of abnormalities appears to have dropped somewhat in most of the cases, and markedly in one, during the intervening 13 months. (auth)

23176 RANGE OF LOW-ENERGY PROTONS IN PROTEIN. Stanley Person, Franklin Hutchinson, and Donald Marvin (Yale Univ., New Haven). Radiation Res., 18: 397-406(Mar. 1963).

The ranges of protons in protein layers were measured for energies from 2 to 75 Kev. The protein layers serve as radiation detectors as well as stopping molecules. The range-energy relation is characterized by an increase in dE/dx as the proton energy is decreased to 10 Kev, and by a sharp knee in the curve at this energy. Although the present data differ from previous data obtained with simpler stopping substances, possible explanations are presented to account for this apparent discrepancy. Range spread measurements and an examination of possible errors introduced by the method do not appear to account for the nature of the observed range energy relation. (auth)

23177 APPLICATION OF THE TARGET THEORY TO MULTISTEP REACTIONS. Helmut Pauly and Boris Rajewsky (Max-Planck-Institut für Biophysik, Frankfurt am Main). Radiation Res., 18: 409-20(Apr. 1963).

A formula describing the dose dependence of a chemical reaction, catalyzed by a chain of consecutive enzymes as, for example, the glycolytic or respiratory chain or synthetic reactions was derived. The formula contains two parameters: α, describing the radiosensitivity of the most sensitive enzyme of the chain, and R, the kinetic constant reflecting the turnover numbers of the steps and the number of the steps themselves. The applicability of the formula is shown for the dose dependence of tissue respiration after x irradiation of several rat tissues. (P.C.H.)

23178 EFFECT OF IRRADIATION IN INFANCY ON THE FERTILITY OF FEMALE MICE. Hannah Peters and Emilia Levy (Finsen Lab., Copenhagen). Radiation Res., 18: 421-8(Apr. 1963).

Studies were made on the effects of a single dose of 20 r of x radiation to mice at different ages during infancy on the reproductive performance in an attempt to establish whether there is a variation in the physiological response of the ovary to radiation given early in life. A marked variation was found. The greatest sensitivity was found at the end of the third week at which time irradiation with 20 r of x rays impairs all reproductive functions markedly and reduces the total reproductive capacity to 1.4% of the normal. (P.C.H.)

23179 EFFECT OF X-IRRADIATION ON THE PITUITARY-ADRENAL AXIS OF THE RAT. Robert T. Binhammer and John R. Crocker (Univ. of Cincinnati). Radiation Res., 18: 429-36(Apr. 1963).

Whole-body x irradiation (1000 r) caused rapid increase in pituitary ACTH activity, reaching a minimum approximately 0.5 hour after exposure. Concomitantly, there was depletion of adrenal ascorbic acid, which reached a minimum approximately 1 hour after exposure. Pituitary ACTH activity and adrenal ascorbic acid returned to normal levels by 24 hours after irradiation. Sham irradiation also caused decreases in pituitary ACTH activity and adrenal ascorbic acid, but the alterations were greater in irradiated animals. The results are consistent with the hypothesis that irradiation acting as a stressor caused release of ACTH from the pituitary. (auth)

23180 EFFECTS OF CONTINUOUS LOW-LEVEL COBALT-60 GAMMA RADIATION ON AN IN VITRO MAMMALIAN CELL SYSTEM. I. RESPONSE TO VARYING DOSE RATES. A. Hellman and D. J. Merchant (Univ. of Michigan, Ann Arbor). Radiation Res., 18: 437-45(Apr. 1963).

A system was developed, with mammalian cells grown in vitro, which provides a method for the rapid detection and quantitation of continuous low-level radiation effects. The method indicates that there is a linear relationship between the dose rate and the changes in generation time of the irradiated cultures. Possible mechanisms of chronic radiation action are discussed in light of acute radiation data, and the results on chronic radiation are presented. (auth)

23181 EFFECT OF NATURAL AND PURIFIED DIETS ON SURVIVAL OF X-IRRADIATED MICE. H. Dymsza, S. A. Miller, and J. F. Maloney (Massachusetts Inst. of Tech., Cambridge). Radiation Res., 18: 461-72(Apr. 1963).

After a 7-day feeding of either natural or purified types of diet, the effects of a high-level (LD_{90}) dose of 750 r of whole-body x irradiation given at a dose rate of 45 r/min were determined by 30-day survival of mice. Dietary variables in the five natural diets included simple and complex formulation and vitamin and mineral supplementation. The five purified diets contained different moisture and lipid levels. One diet was supplemented with yeast, a

natural product. Average 30-day per cent survival of x irradiated mice fed the purified diets was significantly greater (34%) than that of similarly irradiated mice fed the natural diets (16%). However, when the purified diets were made up in a 52% moisture agar gel form, average survival was reduced to 10%. The reasons for the survival differences are unknown. Nevertheless, the data add further support to the contention that the diet can be an important factor in the response of organisms to ionizing radiation exposure. (auth)

23182 INHIBITORY EFFECT OF PREIRRADIATION SACCHARIN HABITUATION ON CONDITIONED AVOIDANCE BEHAVIOR. William A. McLaurin, John A. Farley, and Barron B. Scarborough (Florida State Univ., Tallahassee). Radiation Res., 18: 473-8(Apr. 1963).

A total of 40 male and female albino rats were assigned to four treatment groups with 10 subjects in each group. Three groups were given a 6-day period of habituation to a 0.1% saccharin solution with an interpolated interval of 0, 3, or 6 days on tap water between the end of the 6-day habituation period and the irradiation exposure. The control group had no preirradiation habituation to the saccharin solution. All groups were permitted to drink the 0.1% saccharin solution for 30 minutes and then were exposed to whole-body irradiation for 15 minutes, which resulted in a summated exposure dose of 102 r in air. Preirradiation habituation to saccharin solution was found to have a significant inhibitory effect on conditioned avoidance behavior. Intervals of 3 and 6 days on tap water between the end of the habituation period and radiation exposure showed mixed effects over days, but all habituated groups were significantly different from the nonhabituated group except the 6-day interval group on the first postirradiation day. (auth)

23183 RADIO-ORTHOPHOSPHATE UPTAKE INTO DNA, AUTORADIOGRAPHY AND HISTOLOGY DURING RADIATION-INDUCED REGRESSION AND REGROWTH OF MOUSE MAMMARY ADENOCARCINOMA. Kelly H. Clifton and Halvor Vermund (Univ. of Wisconsin, Madison). Radiation Res., 18: 516-27(Apr. 1963).

The incorporation of P^{32} into deoxyribonucleic acid (DNA) of grafted mammary adenocarcinomas in C3H/WR mice was studied in conjunction with changes in tumor size and morphology after irradiation. Suppression in P^{32} incorporation immediately after x-ray exposure was found to be probably due in the main to prevention of cells from entrance into DNA synthesis. The effect of a second exposure to 4500 r at 2 to 47 days after the first 4500-r dose was dependent on the rate of P^{32} uptake at the time of the second dose. Longer-term experiments revealed no correlation between P^{32} uptake and the stage or rate of tumor regression or regrowth after exposure. In the light of the data and other considerations, it was concluded that measurement of precursor incorporation into DNA is not a valid index of damage to an irradiated cell population. (auth)

23184 ACUTE EFFECTS OF ROENTGEN RADIATION ON MOUSE MAMMARY ADENOCARCINOMA: RADIO-ORTHOPHOSPHATE UPTAKE BY DEOXYRIBONUCLEIC ACID. Kelly H. Clifton and Halvor Vermund (Univ. of Wisconsin, Madison). Radiation Res., 18: 528-39(Apr. 1963).

Irradiation of the whole body or locally to a transplanted mammary adenocarcinoma in inbred mice resulted in a similar immediate suppression of P^{32} incorporation into the DNA of the tumor. The decrease in uptake of P^{32} into DNA was proportional to the log of the x-ray dose in mammary tumors and hyperplastic mammary glands from mice and in regenerating rat liver over the dose ranges tested. The suppression to about 50% after 4500 to 9000 r and the previously reported inability to distinguish between the effects of doses within this range are probably attributable to the shallow slope and the exponential nature of the dose-response curve, and to differences between tumor strains in the slope of the regression lines. (auth)

23185 EFFECTS OF CONTINUOUS LOW-LEVEL COBALT-60 GAMMA RADIATION ON AN IN VITRO MAMMALIAN CELL SYSTEM. II. RECOVERY AND THE EFFECTS OF HYPOTHERMIA. A. Hellman and D. J. Merchant (Univ. of Michigan, Ann Arbor). Radiation Res., 18: 580-92(Apr. 1963).

Cell recovery was observed in L-M strain mouse cell populations exposed to 4.8 r of chronic irradiation per hour over a 7-day period, if a rest period of 8.5 hours was allowed prior to re-exposure of the cell populations to further radiation. A cell population exposed to longer periods of 4.8 r of chronic radiation per hour demonstrated a recovery capacity, if not exposed to more than 1612 r (cumulative dosage). Beyond this cumulative dose complete recovery was not demonstrable. It was postulated that an irreversible mitotic block is imposed above a certain threshold of radiation damage. A reduction in incubation temperature of chronically irradiated cultures from 35 to 30°C significantly enhanced radiation effects on the cell population; a tripling of the generation time and appreciable lengthening of the lag phase was noted. This suggests that the mitotic delay is potentiated and/or a biochemical repair process is markedly reduced at a reduced temperature. Morphological observations were correlated with some of the physiological findings. (auth)

23186 REACTIONS OF DEOXYRIBONUCLEIC ACID RADICALS WITH SULFHYDRYL COMPOUNDS IN X-IRRADIATED BACTERIOPHAGE SYSTEMS. P. Howard-Flanders, Jack Levin, and Lee Theriot (Yale Univ., New Haven). Radiation Res., 18: 593-606(Apr. 1963).

The effects of oxygen and nitric oxide on the inactivation of T2 phage by x rays were investigated both when the free phage was suspended in nutrient broth and when it had adsorbed to the host E. coli B. It was found that, when protected from indirect radiation effects by nutrient broth, the free phage is protected 1.8-fold by hydrogen sulfide and mercaptoethanol, but that this protection is reversed by oxygen or nitric oxide. At higher concentrations of sulfhydryl (20 to 200 mM), the protection is no longer fully reversed by the gases. Analysis of the results indicates that, as regards effect on x-ray inactivation, oxygen and the sulfhydryl are in competition. It is suggested that the substances compete for radioinduced phage DNA radicals, and that anoxic protection is the result of reaction between the sulfhydryl and the phage DNA in which the sulfhydryl donates a hydrogen atom. It appears that the sulfhydryls react about one-thirtieth as rapidly as oxygen with the DNA radicals. The results are discussed in terms of reaction mechanisms. (P.C.H.)

23187 GLYCEROL AND WATER EFFECTS ON X-RAY SENSITIVITY IN STAPHYLOCOCCUS AUREUS. R. B. Webb (Argonne National Lab., Ill.). Radiation Res., 18: 607-19(Apr. 1963).

The variation of x-ray sensitivity of Staphylococcus aureus was studied over a range of glycerol concentrations to 95%. The relationship follows closely that described by the Langmuir adsorption equation. Extrapolation of the relationship to infinite glycerol concentration gives values

of less than one-twentieth of the sensitivity of the cells in phosphate buffer. The results are not consistent with glycerol acting primarily either to prevent the oxygen-enhancement effect or by protection through the simple removal of water from the cells. Simple dehydration of the organism does not decrease x-ray sensitivity, provided a protective agent is not added before drying. It is proposed that protection by glycerol occurs through the adsorption of glycerol on sites usually occupied by water at the surface of important macromolecules within the cell. (auth)

23188 THE PHAGE-NEUTRALIZING ACTIVITY OF THE PROPERDIN SYSTEM IN RABBITS EXPOSED TO ACUTE IRRADIATION. F. A. Paolini, A. Trenta, and A. Cavina Pratesi (Università, Pavia, Italy). Radiobiol. Latina, 5: 197-203(July-Sept. 1962). (In French)

Results are presented from research on the phagoneutralizing activity of the properdin system in the serum of rabbits having undergone acute total-body-irradiation with doses of 600 and 2000 r. The titulation method with the T_2y bacteriophage according to Pernis and Cow was used. Preliminary investigations showed by means of contemporary dosages that the method is rather sensitive. A decrease of the phage-neutralizing activity of the serums was found, being more evident in rabbits treated with higher dosages of roentgen rays. Results were similar to ones reported using the Zymosan technique. The lack of correlation between the personal data and those obtained by the Zymosan technique might be explained by Barlow's hypothesis, who believes that properdin is formed by a mixture of macromolecules, all of them reacting with Zymosan, although showing a different behavior as concerns the phagoneutralizing activity, which is exerted only by a part of the macromolecules. (auth)

23189 THE POST-IRRADIATION BEHAVIOR OF RIBONUCLEIC ACID (RNA) IN CELLS OF THE GRANULAR AND PURKINJE LAYERS OF THE CEREBRAL CORTEX OF RATS. Renato Sorrentino, Giovanni Savino, and Maria Luisa Tognacca (Università, Messina, Italy and Ospedale Maggiore, Novara, Italy). Radiobiol. Latina, 5: 231-8 (July-Sept. 1962). (In Italian)

A spectrophotometric quantitative study was made of the behavior of RNA in the cells of the granular layer and of Purkinje's layer of the cerebellar cortex of rats treated by external teleirradiation with gamma rays of Co^{60} by a beam concentrated on the cephalic region. The animals were treated respectively with doses of 1500 and 3000 rad and were sacrificed some 10 min, 6 hours, 24 hours, and 7 days after completing treatment. The behavior in cells of the granular layer and of Purkinje's layer was quite similar and consisted in a decrease of RNA which was present already 10 min after irradiation and increased after 6 hours, decreasing gradually after 24 hours to basal values after 7 days. These variations were more evident in animals treated with 3000 rad. (auth)

23190 THE POST-IRRADIATION BEHAVIOR OF DESOXYRIBONUCLEIC ACID (DNA) IN CELLS OF THE GRANULAR AND PURKINJE LAYERS OF THE CEREBELLAR CORTEX. Giovanni Savino, Renato Sorrentino, and Maria Luisa Tognacca (Università, Messina, Italy and Ospedale Maggiore, Novara, Italy). Radiobiol. Latina, 5: 241-51(July-Sept. 1962). (In Italian)

Results are reported from a quantitative spectrophotometric investigation on the modifications of DNA in the cells of the granular layer and of Purkinje's layer of the cerebellar cortex of rats treated by telecobalt irradiation concentrated on the head. The determinations of the nuclear quantities take into account the nuclear volume. The animals were treated with doses of 1500 and 3000 rad and sacrificed 10 min, 6 hours, 24 hours, and 7 days after completing the irradiation. The modifications were practically the same in both cellular types, but slightly more evident in animals treated with 3000 rad and consisted in a decrease of the absolute nuclear quantity of DNA which was evident already 10 min after irradiation. This decrease showed a gradual attenuation during the following period. A decrease of the nuclear volume was more evident in the cells of the granular layer. (auth)

23191 THE ELECTROPHORETIC BEHAVIOR OF LIPOPROTEINS OF CHOLESTEROL AND OF TOTAL LIPIDS IN CANCER PATIENTS EXPOSED TO IRRADIATION. G. Savino, R. Sorrentino, and Ezio Fumagalli (Ospedale Maggiore, Novara, Italy). Radiobiol. Latina, 5: 253-61(July-Sept. 1962). (In Italian)

A study was made of the electrophoretic behavior of serum lipoproteins, cholesterol, and total lipids in 50 cases of tumors treated by radiation. After the radiation treatment, they found a decrease of the beta-alpha serum lipoprotein relationship, whereas there were no changes of cholesterol and total lipids. (auth)

23192 EXPERIMENTAL AND CLINICAL RESULTS OF PROTECTION FROM IONIZING RADIATIONS. R. Vertua and F. Casolo (Università, Milan). Radiobiol. Latina, 5: 263-83(July-Sept. 1962). (In Italian)

A short review is presented of some important aspects of the mechanism of the biological action exerted by ionizing radiations and of the clinical syndrome arising in organisms as a consequence of exposure to ionizing radiations. The different categories of radioprotective substances and the theories on their mechanism of action are summarized. Attention is given to the effects, and the mechanism of action, of suspensions of homogenized spleen and bone marrow preparations. The problems connected with the metabolism of radioactive material deriving from fallout, the therapy to be adopted in such cases, and research work on antiradiation drugs are discussed. (auth)

23193 PRACTICAL CRITERIA OF PROTECTION IN RADIUM THERAPY. B. Bonomini (Ospedale Civile, Padua). Radiol. Med., 49: 378-95(Apr. 1963). (In Italian)

On the basis of the results of measurements taken in the Radium Section of the Radiotherapy Division of Padua Civil Hospital, the author summarizes general and practical suggestions for the protection of personnel in wards where radioactive sources are used for the treatment of hospitalized patients. In particular he considers it advisable that radium sources be kept in containers with separate drawers for each source; that the table used for handling the sources and the sterilizers be situated immediately next to the safes; that the room for application to patients be close to the storage premises; and that the wards and rooms of patients bearing radioactive sources be close to the operating theater. He suggests that the personnel, who are the most exposed to the radiations for the necessity of service, be chosen from individuals over 45 years of age and be suitably rotated. (auth)

23194 CONSIDERATIONS ON THE CHANGES IN THE BLOOD CAPILLARIES AFTER IONIZING RADIATIONS. II. HISTOLOGIC AND HISTOCHEMICAL STUDY OF THE BLOOD CAPILLARIES OF THE FROG TONGUE AFTER SINGLE EXPOSURE TO X RAYS (2000, 5000, 10,000 r). A Marin, C. Meneghini, S. Mezzanotte, and U. Scarpis (Università, Padua). Riv. Anat. Patol. Oncol., 18: 606-22 (Nov. 1960).

The tongue was examined microscopically with various staining techniques 5, 15, and 30 days postirradiation. The mucous glands were consistently reduced in thickness, independent of the dose. As seen by the periodic acid-Schiff (PAS) reaction, the polysaccharide material took on a homogeneous appearance after irradiation in contrast to its granular form in control sections. The number of capillary vessels appeared to be increased 5 days after irradiation at all dose levels, whereas after 15 days the number was fewer than in control specimens. At 30 days, further changes were noted: with the 2000-r dose the number of vessels was normal but with the 2 higher doses the number was below normal and many vessels were occluded. The occlusion resulted from hypertrophy of endothelial cells, and the basement membrane was thickened and stained more intensely than normal. The early apparent increase in the number of capillaries could not be traced to newly formed vessels but to dilatation of pre-existing ones. This increase in luminal diameter following irradiation was subsequently (at 15 to 30 days) obliterated by swelling of endothelium. Hemorrhagic changes were present at 5 days after all 3 doses but at 30 days were evident only after 5000 and 10 000 r. The findings are interpreted as indicating that interstitial polysaccharides are depolymerized by radiation and that the thickening of the capillary basement membrane represents increased permeability and accumulation of glycoproteins from the blood. (TCO)

23195 THE ECOLOGICAL EFFECTS OF RADIATION. George M. Woodwell. Sci. Am., 208: 40-9(June 1963).

Results are reported from large-scale field studies of the effects of chronic radiation exposure on ecosystems. Detailed results are described for a pine-oak forest and a field of weeds. Results indicate that forests are much more radiosensitive than weeds and pine trees are more sensitive than oak trees. (C.H.)

23196 STERILIZATION OF SOIL BY IRRADIATION AND SOME FURTHER OBSERVATIONS ON SOIL ENZYME ACTIVITY. A. D. McLaren, R. A. Luse, and J. J. Skujins (Univ. of California, Berkeley). Soil Sci. Soc. Am. Proc., 26: 371-7(July-Aug. 1962).

In a study of radiosterilized soil as a medium for microbial and plant growth, survival curves for microorganisms were obtained with 5- and 9-Mev electrons, and hard x and γ radiation. For a given soil, bacterial survival curves with these radiations were almost superimposable, but they differed among soils. Bacterial numbers in soils approached zero at 2-Mrep doses, but 4-Mrep doses were necessary to insure complete sterility for larger soil volumes. The number of surviving fungi approached zero with doses of about 0.5 Mrep with either of the irradiation treatments and in either Dublin or Yolo soil. The course of reinvasion of sterilized soil by chance contamination was followed after sterilization with a dose of 4 Mrep. Soil was exposed to air in the open and watered with a nutrient solution and then tap water. Bacterial numbers in the soil increased about 15-fold over the normal numbers in nonirradiated control soil after 21 days. There was no significant difference in growth of tomato or barley between irradiated and nonirradiated soil. Although phosphorus-deficient plants had stunted growth, well-fertilized plants had excellent growth; none showed any signs of toxicity. Macroscopic examination of plants grown in irradiated and nonirradiated soil showed no differences in root appearance. Soil sterilized by radiation still manifests enzyme activity (phosphatase, urease) in the presence of suitable substrates. (TCO)

23197 COMPARATIVE SPIROMETRIC STUDIES BEFORE AND AFTER Co^{60} IRRADIATION OF PATIENTS WITH BRONCHIAL CARCINOMA. A. Lichterfeld, W. Widow, and R. Zahnert (Medizinische Universitaetklinik und Poliklinik der Charité, Berlin). Thoraxchirurgie, 9: 178-85(Aug. 1961).

Changes in respiratory function were evaluated after radiotherapy in 46 patients with lung cancer. Spirometric tests were conducted shortly before irradiation and 4 to 6 weeks after local γ-radiation doses of 3500 r delivered over 2 to 3 weeks. A few patients received 6000 r over 4 to 5 weeks, and 40 unirradiated controls were also examined. In general, respiratory function was diminished following irradiation. The disturbances were most marked in the group receiving the higher dose, in which vital capacity fell by an average of 728 cm^3 (25%) postirradiation. With lower doses the decrease was 7%. The decrease was greater after irradiation of supraclavicular fields. In over half the cases, radiotherapy resulted in regression of the tumor and an improvement of radioinduced atelectasis, which sometimes resulted in an improvement in the Tiffeneau test values. Radiation injury in the lung could be detected radiographically in only 8 cases, indicating that spirometry and histologic examination are more sensitive means of detecting the injury. It was concluded that preoperative radiotherapy of lung cancer may impair the patient's chances for recovery because of the resulting disorders in pulmonary function. (TCO)

23198 TUMORS FOLLOWING RADIATION ABOUT THE EYE. Arnold W. Forrest (Columbia Univ., New York). Trans. Am. Acad. Ophthalmol. Otolaryngol., 65: 694-717 (Sept.-Oct. 1961).

Cases of malignant and benign tumors following radiation for retinoblastoma are discussed. A survey of 170 patients given radiotherapy for retinoblastoma showed development of secondary tumors in 9 (5.3%). All the patients but 1 received the substantial radiation dose generally recommended in the past 20 yr, the notable exception being a patient who developed a basal cell carcinoma following a dose that was of the order of $\frac{1}{6}$ the usual dose. In 8 cases of malignant tumor reported following radiation for retinoblastoma after intervals ranging from $5\frac{1}{2}$ to 29 yr after treatment, the onset of a new disease was heralded by the appearance of a mass in or near the radiated areas. Most were subcutaneous, but one of these lay behind the eye and resulted in exophthalmos. A subcutaneous mass was the presenting complaint in 7 of 10 cases. An additional 9 patients with malignant tumor following radiation for retinoblastoma ranged in age from 7 to 30 yr; 8 of these were 16 yr old or younger. The interval between initial treatment and postradiation neoplasm ranged from 4 to 26 hr. In all but 1 case, the postradiation neoplasm occurred within 16 yr. The average interval of appearance for osteosarcoma was 6.5 yr; for rhabdomyosarcoma, fibrosarcoma, mesenchymoma, and undifferentiated sarcoma, 12 yr; for chondrosarcoma, 9 yr; and for carcinoma, 15 yr. Three additional adult cases are reported concerning skin lesions that occurred following radiation in the area of the eye. (TCO)

23199 STUDIES ON THE OVULE STERILITY OF IRRADIATED POPULATIONS OF BRASSICA JUNCEA COSS. A. K. Roy Choudhury and R. P. Dasgupta (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta), 24: 207-10(Dec. 1961). (In English)

The sterility of ovules in mature pods of mustard, Brassica juncea, a self-fertilizing oilseed plant, was

found to be increased by doses of 50,000 and 100,000 r x radiation. No significant differences was observed in the rate of sterility produced by the two doses. (C.H.)

23200 ON THE MODE OF ACTION OF SOME TREATMENTS THAT INFLUENCE THE RADIATION SENSITIVITY OF CELLS. Peter Alexander (Royal Cancer Hospital, London). Trans. N. Y. Acad. Sci., 24: 966-78(June 1962).

Experiments in model systems showed that there were at least 3 distinct processes by which SH compounds may reduce the magnitude of the radio-induced damage in macromolecules: competitive removal of free radicals formed by irradiation in the aqueous phase, energy transfer to the protective substance from the molecule originally ionized before chemical changes occur, and repair of a radiation-produced radical in a macromolecule that converts it back to its original state before it has undergone an irreversible reaction such as crosslinking or peroxidation. Protection of vegetative cells by cysteamine was shown to occur by the last mechanism. The repair process occurs equally with radicals produced in macromolecules by the direct action of ionizing radiations and by indirect action where an OH radical formed in water abstracts a hydrogen atom. After γ irradiation of the nuclei of fish sperm, cross-linking of DNA was observed and cysteamine protected very effectively against cross-linking. Electron spin resonance (ESR) was used to follow the fate of radicals. The results established that the following reactions occur when the nucleoprotein (abbreviated RH) is irradiated: $RH \xrightarrow{\text{irradiation}} R$ free radical; in absence of oxygen $R^{\cdot} + R^{\cdot} \rightarrow R{-}R$ (cross-linked DNA) (reaction I); in presence of oxygen $R^{\cdot} + O_2 \rightarrow RO_2^{\cdot}$ (peroxidized DNA) (reaction II); and in presence of cysteamine (RSH) protection occurs by repair $R^{\cdot} + PSH \rightarrow PS^{\cdot}$ (sulfur free radical) RH + (repaired DNA) (reaction III). A study of the effect of whole-body radiation on ribonuclease (RNase) in the cells of different organs of the rat showed an increase in the level of the enzyme in spleen and thymus that was almost wholly abscopal. No increase in RNase was observed in other organs. The changes in lymphatic cells induced indirectly by irradiation of the head may change their radiosensitivity. (TCO)

23201 AUTORADIOGRAPHIC AND SPECTROMETRIC DEMONSTRATION OF INTRASTITIAL THORIUM DIOXIDE. Charles T. Knorpp, Mary H. Rennie, Robert E. Hodges, and Donald R. Korst (Veterans Administration Hospital, Ann Arbor, Mich.). Univ. Mich. Med. Bull., 27: 44-9(Jan.-Feb. 1961).

The development of a thorotrastoma along the carotid artery in a patient following intravascular injection of thorotrast is described. Intrastitial Th was demonstrated by external counts, gamma assay of biopsied material, and autoradiography in the patient 10 years after the arteriogram using ThO_2. The residual contrast medium was initially discovered on routine x-ray films for arthritis of the spine. Pathologic examination of the involved tissue revealed deposition of granular brown pigment within lymph node, adipose tissue, and salivary gland. Autoradiograms of the various tissues exposed for 3 months showed heavy alpha tracks as well as the intense deposition of Ag over the tissue. The radiation dose received from Thorotrast deposits is discussed and the carcinogenic activity of such deposits is reviewed briefly. (TCO)

23202 EFFECTS OF P^{32} DECAY ON TRANSDUCTION BY SALMONELLA PHAGE P22. Philip E. Hartman and A. W. Kozinski (Johns Hopkins Univ., Baltimore). Virology, 17: 233-44(June 1962).

A study was made of the effect of DNA-incorporated P^{32} decay on the survival of bacterial genes carried by phage particles competent in complete and abortive transduction. In heavily P^{32}-labeled phage particles, plaque formation and abortive transduction activities are inactivated at similar exponential rates. The rate of inactivation of abortive transduction is uninfluenced by the recipient utilized in the transduction assay (single-site or multi-site mutations) or by preadsorption to, and subsequent growth of, recipient bacteria. It was concluded that P^{32}-inactivating lesions are almost exclusively confined to the DNA and simultaneously inactivate the functioning of the entire genetic element or inactivate the ability of the genetic material to be carried by recipient bacteria in functional form. The formation of complete transductional clones is exponentially inactivated in P^{32}-labeled free particles at 0.08 to 0.2 the rate of inactivation of plaque formation. It was concluded that P^{32} lesions do not have as their prominent inactivating effect a permanently incapacitating damage to the bacterial genes actually incorporated to engender the wild-type recombinant, but rather affect gene function and the recombination process in some more indirect manner. (TCO)

23203 EFFECTS OF X RAYS ON TRANSDUCTION BY SALMONELLA PHAGE P22. Hiraku Takebe and Philip E. Hartman (Johns Hopkins Univ., Baltimore). Virology, 17: 295-300(June 1962).

Effects of direct x irradiation and of irradiated solutions on suspensions of Salmonella typhimurium phage P22 were investigated. Direct and long-term indirect effects (after-effects) of x rays were studied in separate experiments. Exponential inactivation curves with ~ single-hit kinetics were obtained for phage inactivation by direct and by indirect effects. Both direct and indirect effects inactivated abortive transductions exponentially with ~ single-hit kinetics and at a rate not significantly different from that for plaque formation. The rate was independent of the recipient (single-site or multisite mutation) used. The results led to the interpretation that abortive transduction requires the presence of a complete, undamaged genetic element of ~ the same size and general chemical structure (double-stranded DNA) as that required for plaque formation by infective P22 particles. A small rise in the number of complete transductions was observed at very low doses of direct effects. After-effects elicited a more consistent and pronounced increase in the number of complete transductions recovered at short times of exposure. Complete transductions were inactivated by direct effects at a rate 0.30 to 0.50 that of inactivation of plaque formation. Inactivation of complete transductions by indirect effects exhibited a relative inactivation rate of about 0.30. The results indicate that the portion of the element sensitive to x-ray inactivation has a maximum size equivalent to about 2/5 the DNA of an infectious particle. (TCO)

23204 ON THE INDUCTION OF PROTOTROPHIC SACCHAROMYCES MUTATIONS BY ULTRAVIOLET LIGHT IN DEPENDENCE ON DOSE AND AFTER TREATMENT. Klaus Haefner and Wolfgang Laskowski (Freie Universität, Berlin). Z. Naturforsch., 18b: 301-9(Apr. 1963). (In German)

A formula for the determination of uv-induced mutation rates in haploid yeast strains is given. In a Saccharomyces strain dependent on adenine, uracil, and histidine the mutation rates of functional backmutants depending on irradiation dose and certain post-irradiation treatments are determined. The results obtained are compared with certain mutation rates previously obtained for recessive lethal alleles. (auth)

23205 MUTATION FREQUENCY OF PLANTS AND PROBABILITY. F. Weiling (Universität, Bonn). Z. Naturforsch., 18b: 310-13(Apr. 1963). (In German)

For a plant model in which the spore-forming tissue arises on the average from the same fraction of the appropriate initials, a theoretical calculation of the x-ray-induced mutation frequency is possible on the basis of probability theory. Since the sum of these frequencies is equal to the number of plants which survive the radiation, it may be possible to calculate the unknown probability of mutation of an initial for a given survival rate. The breadth of the calculated probability not only includes the frequencies of spontaneous and artificially induced mutations, but goes beyond this. (auth)

23206 ON A CHANGE IN THE SPECTRUM OF SOMATIC MUTATIONS IN EPHESTIA KUEHNIELLA Z. BY TEMPERATURE TREATMENT BEFORE IRRADIATION. Ernst-Arnold Loebbecke and Otto Oltmanns (Universität, Cologne). Z. Vererbungslehre, 92: 246-51(1961).

Pupae were maintained at different temperatures (−7, 3, 30, 35, 40°C) for 6 hr before being exposed to 800-r doses of x rays. The incidence of 4 types of scale mutations (ES 1, ES 2, ES 3, ES 4) in the butterflies was studied. It was found to vary significantly according to temperature. The ratio of ES 1/ES 2 mutations was lowest (5 : 1) at −7° and highest (11 : 1) at 35°. The ES 1 mutant showed highest frequency at 25° and fell to the lowest value after preincubation at 40°. The ES 2 mutant reached its lowest incidence at 35°. The ES 3 mutant varied inconsistently and ES 4 frequency was only slightly dependent on temperature. The preincubation temperature of 40°, the lethal limit for the species, generally depressed mutation frequency. The precise reason for the effect of temperature on mutation frequency is unknown but it was previously found that chromosome fragmentation and translocation were reduced at elevated temperatures. (H.H.D.)

23207 INDUCTION OF MUTATIONS BY RADIOISOTOPES. Friedrich Oehlkers and Helga Berdfeld-Gaertner (Universität, Freiburg i. B.). Z. Vererbungslehre, 93: 264-79(1962).

The mutagenic actions of P^{32}-phosphate and S^{35}-sulfate at various concentrations on Oenothera flavens were tested. The relation between chromosome mutations (particularly fragmentations and translocations) and matrix adhesion, terminalization, interstitial chiasmas, and local achromasia was investigated. Only a slight correlation was found between chromosome mutations and matrix adhesion or frequency of terminal chiasmas. The number of interstitial chiasmas increased only slightly with mutations, although the local achromasia was greater than in the controls. A significant increase in chromosome mutations was evident with as little as 20 μC P^{32} per sprout, and the incidence of mutations increased with the activity. With S^{35} solutions, significant increases in mutations were obtained with 400 μC. The distribution of translocations over the genome in the experiments was similar to that previously observed with chemical mutagens. (TCO)

23208 LIMFOIDNYE ORGANYI V LUCHEVOI PATOLOGII. (Lymphoid Organs in Radiation Pathology). Yu. M. Zaretskaya. Moscow, Medgiz, 1961. 114p.

The reactions of lymphoid tissues and organs to radiation are reviewed. Topics discussed in detail include the effects of radiation on morphology and metabolic processes in lymphoid tissues, the direct and indirect effects of radiation on the function of lymphoid organs, and the protective effects of injected or transplanted hematopoietic tissues against radiation injuries. Experiments in bone marrow transplantations in humans exposed to the effect of large doses of radiation are described. (C.H.)

23209 RADIOPROTECTIVE AGENTS. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Feb. 1963. 9p. (SB-511). $0.10(OTS).

References (94) are given to reports and U. S. and foreign journals published from August 1948 through 1962. (P.C.H.)

23210 GENETICALLY SIGNIFICANT DOSE FROM DIAGNOSTIC ROENTGENOLOGY (A STUDY CONCERNING A DEFINED POPULATION IN THE NETHERLANDS). Zwanette Margaretha Beekman. Thesis, Leiden, Rijksuniversiteit, 1962. 138p.

The genetic effects of radiation are reviewed. Data are presented from a survey of the frequency and radiation dose from x ray examinations in a selected population. The genetically significant dose due to diagnostic x ray examinations of this population during 1959 was calculated as 6.8 mr. Procedures for reduction of the radiation dose during diagnostic roentgenology are discussed. (C.H.)

23211 CHANGING PERSPECTIVES ON THE GENETIC EFFECTS OF RADIATION. The Beaumont Lecture. James V. Neel. Springfield, Illinois, Charles C. Thomas, 1963. 105p. $5.00.

Findings are reviewed from a 7-year study on the genetic effects of radiation in man conducted on populations of Hiroshima and Nagasaki. Data are also summarized from all studies to date in which control data were collected at the same time as data on the offspring of irradiated individuals. Results in 4 out of 5 studies indicate that paternal irradiation resulted in an apparent increase in the properties of male births. Pertinent work on the genetic effects of radiation in other mammals and the somatic effects of radiation in man and other mammals is summarized. The role of radiation in producing visible damage to chromosomes as possible mechanisms in radioinduced leukemia is discussed. The hazards to man from exposure to environmental radiation are considered. (C.H.)

Radiation Sickness

23212 (AD-285937) EFFECTS OF DEPLETION OF SOME PHYSIOLOGICAL SUBSTANCES ON THE DEVELOPMENT OF ACUTE RADIATION SICKNESS. Annual Progress Report, September 1, 1961–September 1, 1962. Robert S. Stone (California. Univ., San Francisco. School of Medicine). Contract DA-49-193-MD-2191. 9p.

A preliminary study was made of the effects of whole-body exposure to penetrating ionizing radiations on blood and tissue levels of ascorbic, dehydro-ascorbic, and diketo-gulonic acid in guinea pigs. This was undertaken to test the hypothesis that the rapid oxidation of ascorbic acid to its dehydro-ascorbic form may be responsible for radiobiological damage. (auth)

23213 (TID-16814) STUDIES ON THE MECHANISM OF RADIATION PROTECTION BY PARABIOSIS. L. W. McDonald (New England Deaconess Hospital. Cancer Research Inst., Boston). [Oct. 3, 1962]. Contract AT(30-1)-901. 10p.

A study is described that was made to determine if protection of rats from a lethal dose of radiation by parabiosis is related to the transplantation of immunologically conditioned cells from the nonirradiated to the irradiated mem-

ber of the pair. The results fail to answer the question because it appears that such cells are sometimes transferred between inbred animals of the same sex, regardless of radiation. This in itself is an interesting and important finding. (auth)

23214 (TID-16981) A CONCEPT FOR HUMAN SOMATIC IRRADIATION INJURY. J. Chandler Smith (Western Reserve Univ., Cleveland). [1961]. Contract W-31-109-eng-78. 26p.

The mechanisms of pathogenesis of radiation injuries are reviewed. The nature of the pathologic reactions that are characteristic of the various lesions is discussed. A unified concept of human somatic radiation pathogenesis is presented. (41 references.) (C.H.)

23215 (TID-16982) EXPERIMENTAL RADIATION PNEUMONITIS. J. Chandler Smith (Western Reserve Univ., Cleveland). [1961]. Contract W-31-109-eng-78. 39p.

The pathological features of radiation pneumonitis were studied in rats. Autopsy examinations were performed on rats at intervals of 2 weeks to 5 months after irradiation of the right hemithorax with 3000 r. The morphological reaction sequence included atrophy, hyalinization, accumulation of macrophages in alveoli, depopulation of alveolar lining surfaces, and hyalinization of alveolar walls. The pathologic changes were generally progressive, the reaction developed in the absence of exudative inflammation, and the tissue changes were not detectably modified by cortisone or terramycin, alone or in combination. The reaction of pulmonary tissue to x irradiation may be more appropriately regarded as an induced atrophy due to mitogenic arrest than as an inflammatory response due to ionizing injury. A suggested concept of pathogenesis is that ionizing radiation induces mitotic arrest in the alveolar lining cells which subsequently detach from the alveolar surfaces and either accumulate in the air sacs or are transported out of the lung depending on the capacity of the pulmonary clearance mechanism. This concept is based on a known biologic effect of irradiation, it does not require the process of inflammation, and it is consistent with a temporal account of the events that transpire. (auth)

23216 CHANGES OF ARTERIAL BLOOD PRESSURE IN ACUTE RADIATION DISEASE. Jan Ryzewski (Medical Academy, Warsaw). Arch. Intern. Pharmacodyn., 140: 484-93(Dec. 1, 1962). (In English)

Acute experiments were done in cats and chronic experiments in dogs. The cats were subjected to whole-body x irradiation with a dose of 1500 r, and were examined on the third day after irradiation, when radiation disease was fully developed. Reflexes from the baro- and chemoreceptors were investigated, and arterial blood pressure was recorded in the irradiated cats after intravenous administration of adrenaline, noradrenaline, serotonin, acetylcholine, histamine, Regitine, atropine, or Pendiomid. Dogs were subjected to whole-body irradiation with 800 r; changes in arterial blood pressure, which occurred after the administration of neurohormones, were investigated before and after irradiation. Pressor reflexes in irradiated cats, elicited by clamping and unclamping of both common carotid arteries, corresponded to a rise from 129.6 to 141.4 mm Hg, as compared to pressor reflexes in nonirradiated cats from 106.6 to 146. Reflexes from carotid sinus chemoreceptors evoked by 0.5% KCl were also weaker in irradiated cats. The results of both the acute and chronic experiments indicate that circulatory changes occur in radiation disease. The changes mainly involve responses of the circulatory system to neurohormones and stimulation of vascular baro- and chemoreceptors. (TCO)

23217 THE TOXICITY OF PROCAINE IN THE RADIATION-INJURED MOUSE. Dietrich Winne (Max-Planck-Gesellschaft, Goettingen, Ger.). Arzneimittel-Forsch., 11: 507(May 1961).

Experiments were carried out in mice to determine whether procaine shows altered pharmacologic activity in irradiated animals. The mice were x irradiated with 700 r ($LD_{99.5/30}$) and the convulsive action of procaine was tested 7 days later by intraperitoneal injection of 38 to 91 μg of the drug per gram body weight. The mean convulsive dose for unirradiated animals was 44 μg/g and the same dose was found in irradiated mice. The respective procaine LD_{50} values were 74 and 72 μg/g. Body weight of the irradiated mice fell 15% in the 7-day period. The results indicate that the sensitivity of the mouse to procaine is not affected by the radiation syndrome. (H.H.D.)

23218 THE ROLE OF THE PROTECTIVE ACTION OF RADIOPROTECTORS (CYSTEINE AMINE, CYSTINE AMINE, AND AET) ON THE RADIOMIMETIC EFFECT CAUSED BY OLEIC ACID OXIDATION PRODUCTS. M. L. Kakushkina, N. P. Korolev, and Yu. B. Kudryashov (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 149: 973-5 (Apr. 1, 1963). (In Russian)

Oxidized oleic acid (OOO) shows a similar cytotoxilogical effect as that caused by radiation damage. Thus, it appears that the oxidation products of unsaturated fatty acids take part in the primary reactions occurring in the biosubstrate during irradiation. A 2% solution of human erythrocytes in 0.9% NaCl was less stable to the hemolytic effect of 0.002N HCl when incubated with 6×10^{-3} mg/ml of a standard OOO (oxidized oleic acid) preparation for 15 minutes at 37°C. A similar decrease in resistance to hemolysis by HCl was observed when the solution of erythrocytes was given a Co^{60} dose of 100 to 1000 kr. The addition of a radioprotective agent such as cysteine amine resulted in an almost complete restoration to normal of the irradiated erythrocytes. AET was the most effective protective agent against the effects of radiation, and against the radiomimetic effects of OOO (oxidized oleic acid). The compound α-alanine had no protective effect. Cysteine amine was more effective against radiation than against the radiomimetic effect of OOO. The results indicated that there is a similarity between the radiation damage and radiomimetic damage to living cells. The stability of erythrocytes to hemolysis can be used as a simple biological model for a rapid preliminary evaluation of radioprotective agents. (TTT)

23219 THE EFFECT OF CYSTAMINE HYDROCHLORIDE ON THE DEVELOPMENT AND COURSE OF RADIATION SICKNESS IN PATIENTS ASSOCIATED WITH ROENTGENORADIUM THERAPY. V. S. Vakhtel and L. F. Sinenko (Kirov Military Medical Academy, USSR). Med. Radiol., 8: No. 2, 13-18(Feb. 1963). (In Russian)

Clinical trials of some chemical protective preparations were conducted on patients subjected to x or gamma irradiation for various diseases, mainly malignant tumors. Cystamine hydrochloride proved to be the most effective agent. 235 patients received cystamine during irradiation. The prophylactic effect was most pronounced when the preparation was given in tablets 30 to 60 min prior to the irradiation. Single doses of 0.6 to 0.8 g total dose were given up to 40 g and more. Of 130 patients who underwent irradiation of the chest or neck, no signs of radiation affection were noted in 80.8%. Of 72 patients subjected to radium therapy of the abdominal cavity, no symptoms of radiation sickness were found in 50% of the cases. 32 patients developed mild radiation sickness. A stable leukopenia occurred only in 4 cases. There were no signs of

radiation injury in all cases subjected to irradiation of the head. Cystamine hydrochloride is recommended for the prevention of radiation sickness in patients subjected to high doses of x or gamma rays. (auth)

23220 THE USE OF BONE MARROW SUSPENSION IN SUPERLETHAL IRRADIATION OF RATS. K. N. Muksinova. Med. Radiol., 8: No. 2, 25-8(Feb. 1963). (In Russian)

Rats of the Wistar strain were irradiated with superlethal doses of gamma radiation (1200 to 1400 r). 24 hours later an isologous bone marrow suspension was introduced in the amount of 5×10^7, 5×10^8 and 1×10^9 cells per recipient. With increase of the irradiation level, the quantity of cells necessary for the maximal curative effect also rise. In the treatment of rats subjected to 1200 r, the best results were achieved with 5×10^8 cells (survival—32.5%). In irradiation with a dose of 1400 r the highest curative effect was attained with 1×10^9 cells. The possible causes of effectiveness of greater quantities of bone marrow cells at these radiation levels are also discussed. (auth)

23221 DISTURBANCES OF PROCESSES OF BONE MARROW CELLULAR REGENERATION IN RATS AFFECTED WITH IONIZING RADIATION. G. P. Gruzdiev, N. K. Evseeva, L. M. Rozhdestvenskii, M. I. Fedotova, and E. N. Scherbova. Med. Radiol., 8: No. 2, 35-42 (Feb. 1963). (In Russian)

In rats subjected to gamma irradiation in a dose of 400 r, investigations were made on the processes of regeneration (the mitotic index), development chromosomal injuries, total content of myeloid cells, and individual cellular regenerations in the bone marrow. It was demonstrated that the mitotic index cannot characterize the changes of mitotic activity of the myeloid tissue in irradiated animals. The mitotic activity of erythropoietic cells of the bone marrow manifests a steep rise from the third day of radiation sickness (400 r). On the basis of the investigations a supposition can be made that myeloid cells, which divided with manifestations of chromosomal disturbances, give nonviable daughter cellular elements and perish rapidly. (auth)

23222 REDUCED IMMUNOBIOLOGICAL RESISTANCE OF ORGANISM AS A MANIFESTATION OF IRREVERSIBLE COMPONENT IN RADIATION INJURIES. I. G. Akoev and M. A. Lagun. Med. Radiol., 8: No. 2, 47-50(Feb. 1963). (In Russian)

Experimental data exhibited a weakened immunobiological resistance and restorative mechanism in 150 mice exposed to single doses of 750 r and to double exposures, to total doses of 750 r and 900 r. The weakened immunity to bacterial toxins was manifested by the reduced life span of mice infected with Bac. perfringens. (R.V.J.)

23223 EXPERIMENTAL STUDIES OF THE COMBINED EFFECT OF ANTITUMOROUS ANTIBIOTICS AND X-RAYS IN LEUKEMIA. I. I. Zaretskii, A. Ya. Krashilina, L. N. Borisova, and I. B. Gurevich (Inst. of Hematology and Blood Transfusion, Ministry of Public Health, USSR). Med. Radiol., 8: No. 2, 51-7(Feb. 1963). (In Russian)

In experiments on mice of the Afb strain affected with leukemia, the therapeutic effectiveness of a combination of x rays and three new antitumorous antibiotics, aurantine, sodium salt of antibiotic 6613, and antibiotic 16749, was studied. The antileukemic action of x rays intensified when combined with aurantine or sodium salt of antibiotic 6613. This is associated with their differing action on the proliferating cells in comparison with x rays. Contrary to this in combined treatment with antibiotic 16749 and x rays, no intensification of the curative effect occurred, but the general toxic manifestations increased. (auth)

23224 RESIDUAL AND REMOTE SEQUELAE OF ACUTE RADIATION SICKNESS IN MAN. E. N. Antipenko. Med. Radiol., 8: No. 2, 58-65(Feb. 1963). (In Russian)

A survey of published literature on the immediate and remote sequelae of radiation sickness is presented. (R.V.J.)

23225 RADIATION INJURIES BY NUCLEAR WEAPONS. F. C. Pace and W. R. Waters (Dept. of National Health and Welfare, Ottawa). Med. Serv. J. (Can.), 17: 437-47(July-Aug. 1961).

Various types of injury of humans from thermonuclear detonations are discussed, including those resulting from blast, heat, and radiation. The characteristics of early fallout are described, and the symptoms, pathology, and treatment of the acute radiation syndrome occurring in response to exposure to fallout are outlined and discussed. Skin injuries from fallout are considered, especially with reference in the Marshall Islanders and Japanese fishermen exposed in 1954. The internal radiation hazard, resulting from inhalation or ingestion of fission products, is discussed. It was concluded that in no situation in nuclear warfare would it be possible to inhale enough fallout material to injure the respiratory or gastrointestinal tracts. On physical grounds, the acute hazards offered by β and γ emanation to skin and to the organism as a whole are at least 1000 times greater than the inhalation hazards. On physiological grounds (the defense mechanisms of the respiratory tract) there is an additional protective factor of 10; the particles of the early fallout are too large to reach the pulmonary alveoli. The probability of internal contamination by the respiratory route appears to be remote, and can be ignored in the early period after attack. (H.H.D.)

23226 RADIOPROTECTION BY ACCLIMATIZATION TO COLD. Roger Ghys (Université Laval, Quebec). Nature, 198: 603(May 11, 1963).

The effect of acclimatization to cold on the effects of acute and chronic whole-body exposure to Co^{60} γ rays was studied in rats. Acclimatization to 6°C was accompanied by a marked increase in radiation resistance. A radiation protection factor of about 2 was obtained at the LD_0 level. The protective action of cold acclimatization was found to last for at least one week after the rats were returned to a normal environment. The LD_0 for cold acclimatized chronic irradiated rats was significantly higher than the LD_{100} for the same animals submitted to an acute dose of γ rays. It is suggested that cold acclimatization makes it possible to obtain rats that have survived a large dose of radiation for use in studies of late pathological and genetic effects of irradiation. (C.H.)

23227 HISTAMINE THEORY OF THE POST-RADIATION SYNDROME. Cecylia Kwasniewska-Rokicinska (Inst. of Oncology, Gliwice, Poland). Polski Tygod. Lek. Wiadomosci. Lekar., 18: 110-12(Jan. 1963).

The theory that histamine production underlies the post-radiation syndrome is reviewed. Theories not involving histamine are also discussed. (auth)

23228 PHAGOCYTIC ACTIVITY OF THE LEUCOCYTES IN THE RADIATION SYNDROME. A. T. Sharifkhodzhaev (Uzbek Research Inst. of Hematology and Blood Transfusion, USSR). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 21-6(1961).

The phagocytic activity of leukocytes was studied in guinea pigs with different degrees of radiation sickness.

Data are presented on the relation between morphological composition of the peripheral blood and phagocytic activity. Results indicate that changes in leukocyte count most clearly reflect the severity of radiation injury but changes in the phagocytic activity of the leukocytes is the earliest sign of radiation injury. (C.H.)

23229 ORIGINAL ARTICLES AND SURVEYS. A. PROBLEMS OF HEMATOLOGY. THE MECHANISM OF ACTION OF BONE MARROW TRANSPLANTATION IN IRRADIATED DOGS AND MONKEYS. M. O. Raushenbakh, G. V. Sukyasyan, G. I. Kozinets, T. P. Tsessarskaya, M. N. Novikova, L. I. Kazanova, G. A. Chernov, N. Ya. Lagutina, and I. L. Chertkov (Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 83-93(1961).

Homologous bone marrow transplants had a beneficial effect on the restoration of hemopoiesis in fatally irradiated dogs and monkeys. Results are presented from radiometric, radioautographic, cytological, and hematological studies. (C.H.)

23230 HEMOPOIESIS IN HEALTHY ANIMALS FOLLOWING BONE MARROW TRANSPLANTATION. I. I. Zaretskii, V. P. Reshchikov, N. M. Fertukova, and M. P. Khokhlova (Lenin Inst. of Hematology and Blood Transfusion, Ministry of Health, USSR). Probl. Hematol. Blood Transfusion (USSR) (English Transl.), 6: 93-9 (1961).

Hematological, histologic, and radioautographic methods were used to study the distribution of homologous bone marrow and effects on hemopoiesis in mice. It was concluded that changes in hematological factors observed during the first 2 days after injection were caused by reaction to the injection and proteins injected with the suspension. Between the 6th and 7th day the transplanted bone marrow cells were actively incorporated into the hemopoietic process. The transplanted cells were rapidly reduced in number. Differential cells continued their development cycle, were converted into mature blood cells, and entered the circulation. The young, undifferentiated transplanted elements seemingly formed foci of extramedullary hemopoiesis. These areas of hemopoiesis were rapidly destroyed by the development of negative immunological reactions. No evidence of primary or secondary immunological complications was observed after the injection of homologous bone marrow cells in healthy animals. (C.H.)

23231 A COMPARISON OF THE PHARMACOLOGICAL EFFECTS OF SOME COMPOUNDS RELATED TO 2-AMINOETHYLISOTHIURONIUM BROMIDE HYDROBROMIDE (AET). Victor DiStefano, Phyllis S. Korn, and Daniel E. Leary (Univ. of Rochester, N. Y.). Radiation Res., 18: 177-85(Feb. 1963). (TID-15095)

The pharmacological properties of nine compounds formed by substitutions either in the AET or in the APT molecule were studied in cats. None of the compounds elicited the chemoreflex characteristic of the parent compounds. In general, substitutions in the APT and AET molecules attenuated gut responses, amplified ganglionic blocking activity (particularly in AET analogs), and resulted in compounds with some degree of neuromuscular depressant activity. (auth)

23232 IRREPARABLE INJURY AFTER IRRADIATION. I. RADIATION REPAIR IN THE MOUSE. Glen V. Dalrymple, John W. Lane, Melvin E. Capehart, and C. D. Robinette (Univ. of Colorado, Denver). Radiation Res., 18: 321-5 (Mar. 1963).

Two thousand four hundred mice were studied to determine the amount of irreparable injury induced as a function of the amount of the exposure dose. Approximately 3 to 17% of the exposure dose remained as irreparable injury. (auth)

23233 ON THE MECHANISM OF RADIATION PROTECTION BY CYSTEAMINE: AN INVESTIGATION BY MEANS OF ELECTRON SPIN RESONANCE. M. G. Ormerod and P. Alexander (Royal Military Coll. of Sci., Shrivenham, Berks, Eng. and Chester Beatty Research Inst., London). Radiation Res., 18: 495-509(Apr. 1963).

The presence of cysteamine was found to prevent the crosslinking of deoxyribonucleic acid (DNA) when irradiated by γ rays in the form of a nucleoprotein. Electron spin resonance measurements of salmon sperm heads indicated that the protection is brought about by the transfer of a hydrogen atom from the –SH group of the cysteamine to the radicals produced in DNA. In this way the radiation damage in DNA is restored, and radical combination leading to crosslinking is prevented. Oxygen competes with the –SH groups for the radioinduced radicals, and repair by cysteamine is more effective in the absence of oxygen. It is suggested that intracellular –SH compounds are responsible for restitution of radiation damage within cells and that interference with the repair reaction by oxygen is one of the factors responsible for the radiosensitizing action of oxygen. Data on the electron spin resonance spectra at –196°C and at room temperature of irradiated nucleoprotein and its constituents DNA and salmine are also presented. (auth)

CHEMISTRY

General and Miscellaneous

23234 (PA-TR-3053) EVALUATION OF STRUCTURAL ADHESIVES AT TEMPERATURES UP TO 1000°C. John Veliky and Eileen Swick (Picatinny Arsenal. Feltman Research Labs., Dover, N. J.). Dec. 1962. 41p.

Work is being done to determine the shear strengths of several structural adhesives at temperatures ranging from –65 to 800 or 1000°F. A literature survey was conducted on high-temperature-resistant adhesives to determine available types, recommended methods of application and cure, mechanical properties of resultant joints, and methods of testing. Several commercially available high-temperature structural adhesives were investigated for adhesive shear strength properties at various temperatures within the range of –65 to 1000°F. The adhesive types evaluated included: a liquid vinyl phenolic; a nitrile rubber phenolic unsupported film, three modified phenolic resins (each utilizing a glass fabric carrier), a one-component epoxy, and a modified silicone phenolic cured with arsenic pentoxide. It was concluded that adhesives are available that will withstand temperatures up to 1000°F for limited time periods. One such adhesive is a semiorganic compound, which retains some strength at 1000°F but fails when subjected to room temperature immediately after exposure to a temperature of 1000°F. Other adhesives were reported to give good bone strengths at 1000°F. These were mostly modified phenolic types. Some adhesives were found to be excellent for short time exposures at temperatures up to 800°F. They are reported to possess excellent long-time storage characteristics at temperatures around 300 to 400°F. One adhesive gave relatively low bond strength from 180 to 500°F. However, it was recommended for continual service up to 180°F and was reported to endure storage at 350°F for prolonged periods. (auth)

23235 CATHODE LUMINESCENCE OF LANTHANUM OXIDE ACTIVATED WITH RARE EARTHS. S. Terol and J. A. Rovidarcht (Instituto de Optica "Daza de Valdes," C. S. de I. C., Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 291-302(Nov.-Dec. 1962). (In Spanish)

The visible fluorescent emissions excited by cathode rays of rare-earth-activated La_2O_3 phosphors were determined. A comparison of fluorescence data with those from the literature is included. The rare earths from Ce to Lu, with the exception of Pm and Ho, were tested. Cathodoluminescent emission curves, as well as an approximate lower limit of detection of each rare earth added to the La_2O_3, are given. All the available lanthanum oxide samples, even those of highest purity, contained praseodymium. With a La_2O_3 of good quality as a base, and minimizing the Pr band (510 mμ) by proper energy excitation, it was possible, however, to detect in trace concentrations almost all the rare earths, in solid solution, which are not easily detectable by other ways. (auth)

23236 A NUMBER OF REGULARITIES IN THE COMPLEXING OF PENTAVALENT ACTINIDES. A. I. Mockvin, I. Geletseanu, and A. V. Iapitskii (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 149: 611-14(Mar. 21, 1963). (In Russian)

The composition and instability constants for Pa(V), Np(V), and Pu(V) are listed for EDTA and citric, oxalic, phosphoric, trihydroxyglutaric, α-hydroxybutyric, tartaric, malic, mandelic, acetic, and lactic acids. Pa, Np, and Pu form complexes of the same composition, and of about the same strength. The pentavalent actinides do not tend to complex readily, and they differ only slightly in complexing ability between themselves. Thus, Pu(V) forms complexes less readily than Pu(IV) or Pu(VI). The strength of the complexes with various addends can be listed in the following order: EDTA > citric > oxalic > phosphoric > trihydroxyglutaric > α-hydroxyisobutyric > tartaric > malic > mandelic > acetic > lactic. The strength and composition of various U(V) complexes can be derived from a plot of pK_H versus atomic number. The values of pK_H for U(V) complexes with a ratio of metal to addend of 1 : 1 are 3.2 for the oxalate, 9.7 for the EDTA, 2.4 for the tatrate, 2.6 for the lactate, and 4.0 for the citrate complex. These data indicate the similarity in behavior of pentavalent protoactinium, neptunium, and plutonium. (TTT)

23237 STUDIES ON COORDINATION POLYMERS OBTAINED FROM 2,5-DIHYDROXY-p-BENZOQUINONE WITH COPPER, THORIUM AND ZIRCONIUM. B. D. Jain and S. P. Singhal (Univ. of Delhi). Indian J. Chem., 1: 57-8(Feb. 1963).

Conductometric studies on the copper and thorium complexes with 2,5-dihydroxy-p-benzoquinone indicate that these are coordination polymers, because their molar composition depends on whether the metal or the reagent is present in excess. In the complex formed in the presence of excess of the ligand, the ligand forms the chain ends, while in the case of the complex formed in the presence of excess of the metal, the metal forms the chain ends. Molar compositions of the copper complexes were found to be 1 : 0.72 and 1 : 1.25 and of the thorium complexes to be 1 : 1.86 and 1 : 2.2. Infrared absorption spectrum of 2,5-dihydroxy-p-benzoquinone shows two absorption peaks at 1650 and 1620 cm^{-1} due to chelated carbonyls and its zirconium complex indicates two absorption peaks at 1575 and 1550 cm^{-1} which may be attributed to carbonyls chelated to zirconium atoms. X-ray powder diffraction pattern of zirconium chelate with 2,5-dihydroxy-p-benzoquinone shows only two faint haloes indicating it to be a polymerized product. The zirconium complex is thermally unstable at 300°C. Zirconyl complex has the molar composition 1 : 1 and it appears to be a long chain linear polymer. (auth)

23238 COMPOUND EXCITON SPECTRA OF MIXED CRYSTALS OF ISOTOPIC NAPHTHALENES. E. F. Sheka (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Izv. Akad. Nauk SSSR, Ser. Fiz., 27: 503-9(Apr. 1963). (In Russian)

The presence of sharply polarized bands, corresponding to separate components in a H_8-D_8 naphthalene mixed crystal, and the direct relation of their splitting on the concentration can be explained only by assuming the formation of exciton states in the mixed crystal, as a result of which an incident light excites only a specific type of molecule. Determination of the exciton bands make it possible to study the interaction of the mixed components. This problem was further investigated by studying the absorption spectra of various deuteronaphthalenes. The tests were carried out at 20 and 77°K, using substituted naphthalenes ranging from pure H_8 to α-monodeuteronaphthalene (α-D_1), α and β-tetra deuteronaphthalene (α + β – D_4), and octodeuteronaphtha-

lene (D_8). The study was limited to the analysis of the absorption edge in the range of the Davydovskiĭ doublet of the A_1 and B_1 electron transition exciton bands and to the M_1 band of the first electron-oscillation transition. The single electron-oscillation transition bands observed at low concentrations of the H_3 luminescence spectra were transformed into a doublet at higher concentrations. This phenomenon was not observed at pure electron transitions because it is related to the presence of excitons. The quantitative interpretation of the luminescence spectrum was more difficult than that of the absorption spectra. (TTT)

23239 THE STRUCTURE OF PHENYLMAGNESIUM BROMIDE DIETHERATE AND THE NATURE OF GRIGNARD REAGENTS. Galen D. Stucky and R. E. Rundle (Ames Lab., Ames, Iowa). J. Am. Chem. Soc., 85: 1002-3 (1963). (IS-591)

Crystals of $C_6H_5MgBr \cdot 2(C_4H_{10}O)$ are orthorhombic with a = 12.25, b = 12.81, c = 11.02 A, space group $P2_12_12_1$, and Z = 4. Its structure consists of $C_6H_5MgBr \cdot 2(C_4H_{10}O)$ monomers with the phenyl, bromine, and two ethers bonded tetrahedrally to a single Mg atom. The probable species in ether solutions is discussed, and it is concluded that $C_6H_5MgBr \cdot 2(C_4H_{10}O)$ or a higher etherate, but not $(C_6H_5)_2Mg \cdot MgBr_2 \cdot n(C_4H_{10}O)$, is the dominant species in the traditional Grignard reagent. The reaction of $(C_6H_5)_2Mg$ and $MgBr_2$ in ether is discussed. (D.L.C.)

23240 WATER ASSOCIATED WITH THE BIS(8-QUINOLINOL) DIOXOURANIUM(VI) CHELATE EXTRACTED INTO CHLOROFORM. D. R. Gere and C. E. Meloan (Kansas State Univ., Manhattan). J. Inorg. Nucl. Chem., 25: 117-22 (Mar. 1963).

The number of molecules of water associated with the 8-quinolinol chelate of uranium(VI) when it was extracted into chloroform was found to be 5 ± 2 molecules. (auth)

23241 THE ADSORPTION OF DI-n-BUTYLPHOSPHATE FROM ORGANIC SOLUTIONS ON SOME METAL OXIDES. I. J. Gal and Dj. M. Petkovic (Inst. of Nuclear Sciences "Boris Kidrich," Belgrad). J. Inorg. Nucl. Chem., 25: 129-30(Mar. 1963).

The adsorption of DBP from kerosene, 30% TBP–kerosene, and 30% TBP – 0.1 M HNO_3 – kerosene was studied for Al_2O_3, ZrO_2, and SiO_2. The adsorption isotherms can be expressed by Langmuir-type equations. The amounts of adsorbed DBP at saturation for the above solvents are 0.70, 0.50, and 0.85 mmole/g Al_2O_3; 1.10, 0.80, and 0.76 mmole/g ZrO_2; and 0.65, < 0.01, and < 0.01 mmole/g SiO_2. (D.L.C.)

23242 COMPLEXES FORMED BY THE REACTION OF ZIRCONIUM TETRACHLORIDE WITH AMIDES. A. Clearfield and E. J. Malkiewich (National Lead Co., and Niagara Univ., Niagara Falls, N. Y.). J. Inorg. Nucl. Chem., 25: 237-40(Apr. 1963).

Co-ordination complexes of zirconium (IV) chloride with a number of amides were prepared and their infrared spectra examined. The amides are bonded to the zirconium atom through the carbonyl oxygen. Tertiary amides form diaddition complexes. With primary amides products containing more than 2 amide groups per zirconium were obtained. However, it is believed that the metal atom has a co-ordination number of six in these complexes, also. (auth)

23243 THE HEATS OF DISSOCIATION OF THE 8-QUINOLINOL AND SUBSTITUTED 8-QUINOLINOL METAL CHELATES OF URANIUM(VI), THORIUM(IV), AND SCANDIUM(III). G. R. Horton and W. W. Wendlandt (Texas Technological Coll., Lubbock). J. Inorg. Nucl. Chem., 25: 241-5(Apr. 1963).

The heats of dissociation, ΔH, were determined for the reaction: $M(Ox)_n \cdot HOx(s) \rightarrow M(Ox)_n(s) + HOx(g)$ for the uranium (VI), thorium (IV), and scandium (III) complexes of 8-quinolinol (HOx) and substituted 8-quinolinols such as 2-methyl-, 5,7-dichloro-, 5,7-dibromo-, 5-iodo, and 5-iodo-7-chloro-8-quinolinol. Also, the heats of sublimation, ΔH_v, were determined for the above chelating agents in the temperature range of 35 to 160°. These quantities, as well as the K_p, ΔF, and ΔS values, were calculated from dissociation pressure data obtained by a modified Knudsen effusion-cell method. For the 8-quinolinol metal chelates, the order of decreasing ΔH values was: $UO_2^{2+} > Th^{4+} > Sc^{3+}$. For a given metal ion, Th^{4+}, the order of decreasing ΔH values was: $HOxCl_2 > HOx > HOxICl > HOxBr_2 > HOxI$. (auth)

23244 X-RAY AND DIFFERENTIAL THERMAL ANALYSIS STUDIES ON THE 8-QUINOLINOL AND SUBSTITUTED 8-QUINOLINOL METAL CHELATES OF THORIUM(IV), URANIUM(VI) AND SCANDIUM(III). G. R. Horton and W. W. Wendlandt (Texas Technological Coll., Lubbock). J. Inorg. Nucl. Chem., 25: 247-52(Apr. 1963).

The solvated and normal 8-quinolinol and substituted 8-quinolinols chelates of scandium (III), thorium (IV), and uranium (VI) were studied by x-ray-diffraction and differential thermal analysis (DTA). The unit cell dimensions for the chelates were calculated from the x-ray data using Ito's method. DTA studies showed that the solvate molecule was evolved, giving rise to endothermic peaks in the 100 to 300° temperature range. This peak was followed by endothermic peaks caused by the general decomposition reaction. The E_a for the desolvation of $UO_2(Ox)_2 \cdot HOx$ was 28 kcal $mole^{-1}$ while the ΔH was 20 ± 2 kcal $mole^{-1}$. (auth)

23245 DISTILLATION OF RUTHENIUM TETRAOXIDE WITH VOLATILE ACIDS. Yoshio Koda (Government Industrial Research Inst., Nagoya, Japan). J. Inorg. Nucl. Chem., 25: 314-15(Apr. 1963).

The effect of acids, both volatile and nonvolatile, on the distillation yield of ruthenium tetraoxide was studied using Ru^{106} tracer. The volatile acids used were trifluoroacetic acid, acetic acid, nitric acid, and silicofluoric acid either alone or in admixture with H_2SO_4 or H_3PO_4. For HNO_3, yields were > 95%, while for the other volatile acids, use of H_2SO_4 and H_3PO_4 improved the yields. (D.L.C.)

23246 HOMOGENEOUS PRECIPITATION AND X-RAY DIFFRACTION STUDIES OF UREA URANATE. W. Dembinski, A. Deptula, and B. Volavšek (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw and Nuclear Inst. "Jozef Stefan," Ljublijana, Yugoslavia). J. Inorg. Nucl. Chem., 25: 320-1(Apr. 1963).

Urea uranate may be obtained by homogeneous precipitation from solutions of $NH_4OH - UO_2(NO_3)_2 - NH_2CONH_2$ in H_2O and corresponds to the composition $H_2UO_4 \cdot (NH_2CONH_2)_2$. The diffraction patterns were indexed on the basis of an orthorhombic cell with the dimensions a = 7.33 A, b = 10.12 A, and c = 12.10 A. The cell has four formula units and a space group of Pnna-D_{2h}^6. (D.L.C.)

23247 PROMETHIUM OXIDE STRUCTURE. Archie S. Wilson, F. P. Roberts, and E. J. Wheelwright (General Electric Co., Richland, Wash.). Nature, 198: 580(May 11, 1963).

Examination of a sample of promethium sesquioxide powder by means of x-ray diffraction showed reflections consistent with a fluorite-type structure. (C.H.)

23248 PREPARATION OF MIXED COMPLEXES OF THORIUM WITH CUPFERRON AND 4'-NITRO-2,2'-DIOXY-4-METHYL-5-ISOPROPYL AZOBENZENE. V. M.

Dziomko, N. P. Rudenko, and I. N. Kremenskaya (Moscow State Univ.). Zh. Neorgan. Khim., 8: 655-9(Mar. 1963). (In Russian)

Although systems with two different ligands, including a cyclic complex former, were well investigated, considerably less attention was devoted to the study of systems with two polydentate ligands. For this reason, the mixed cyclic complex of Th(IV) with cupferron and 4′-nitro-2,2′-dioxy-4-methyl-5-isopropyl azobenzene was synthesized by mixing the reagents in a solution of chloroform. The final product consisted of fine, dark-violet, needle-shaped crystals. Chemical analysis and molecular weight determination indicated that the molecular ratio of the compound is Th : cupferron : azo compound = 1 : 2 : 1. The coördination number of the Th in the complex is probably 8. (TTT)

23249 THE STRUCTURE OF COMPLEX URANYL COMPOUNDS WITH THE ANIONS OF TARTARIC, MALIC, AND TRIOXY GLUTARIC ACIDS. V. P. Markov, Yu. Ya. Kharitonov, and Z. M. Alikhanova (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 774-5(Mar. 1963). (In Russian)

I. Feldman, et al. (J. Am. Chem. Soc., 76: 4726(1954)) investigated uranyl complexes of organic acids and found multinuclear complexes among the compounds studied. In order to determine the coördination of the anions around the U atom and to clarify the problem of the removal of protons from carboxylic and hydroxyl groups, the infrared spectra of uranyl tartrate, malate, and trioxy glutarate were examined in the 650 to 2000 cm^{-1} region, and the results were compared with those observed with the corresponding free acids and K salts. Strong maxima were found at 931, 942, 946, and 926 cm^{-1}, respectively, in the spectra of the three uranyl compounds, corresponding to the complex $\gamma^3(UO_2^{2+})$; these maxima were absent from the spectra of the K salts and of the free acids. The data allowed the conclusion to be drawn that in the crystalline state all three compounds contain UO_2^{2+} groups and also anions with carboxylic and hydroxyl groups from which a proton is removed. As the coördination number of the uranyl group is higher than two in these compounds, it may be assumed that undissociated hydroxyl groups are also involved in the complex formation. (TTT)

Analytical Procedures

23250 (AE-105) FLAME PHOTOMETRIC DETERMINATION OF LITHIUM CONTENTS DOWN TO 10^{-3} PPM IN WATER SAMPLES. Guenther Joensson (Aktiebolaget Atomenergi, Studsvik, Sweden). Apr. 1963. 9p.

A flame photometric method was developed for the determination of submicro contents of Li in H_2O. The intensity of the emission from Li increases about three times if 20% of a mixture of acetone–amyl alcohol (4 : 1) is added to the sample. Interferences by stray light from Na present is eliminated with a special absorption filter. Interferences from oxide bands of the alkaline earth metals are completely suppressed after adding Al to the sample. With this method it is possible to determine directly 0.01 ppm Li by flame photometry with an error of analysis less than 10%. Also, after concentration of the sample by evaporation, contents down to 10^{-3} ppm can be determined without any difficulty. (auth)

23251 (GAT-T-1085) THE COLORIMETRIC MICRODETERMINATION OF TITANIUM AND VANADIUM IN URANIUM COMPOUNDS USING BENZOYLPHENYLHYDROXYLAMINE. O. A. Vita, L. R. Mullins, Jr., and C. F. Trivisonno (Goodyear Atomic Corp., Piketon, Ohio). Apr. 10, 1963. Contract AT(33-2)-1. 9p.

Separate but similar methods for the rapid microdetermination of Ti and V in U compounds were developed. Titanium(IV) and vanadium(V) both react with benzoylphenylhydroxylamine (BPHA) to form highly colored complexes that can be extracted into chloroform from 8 M or 4 M hydrochloric acid, respectively. The Ti analysis is then completed colorimetrically by measuring the color of its yellow BPHA complex at a wave length of 420 mμ. For the analysis of V, the color of the violet BPHA complex is measured at a wave length of 530 mμ. The methods offer advantages over other available methods because of the selectivity and sensitivity of the reagent for the two elements. Concentrations of Ti as low as 0.2 μg/g of U can be determined. Ten micrograms of Ti can be analyzed with no significant bias and a limit of error of ±6%. Concentrations of V as low as 0.2 μg/g of U can be determined. Five micrograms of V can be analyzed with a limit of error of ±6%. The methods are also applicable to the analyses of a wide variety of other materials. (auth)

23252 (IS-550) X-RAY ANALYTICAL SPECTROSCOPY OF THE RARE EARTHS. Robert H. Heidel and Velmer A. Fassel (Ames Lab., Ames, Iowa). [Sept. 14, 1962]. Contract [W-7405-eng-82]. 13p.

A review is presented on the application of x-ray spectrography to the analysis of rare earths. Analytical spectral lines of the rare earths in lithium fluoride crystals are tabulated. (P.C.H.)

23253 (IS-561) SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION OF RARE EARTHS. Hiroshi Onishi and Charles V. Banks (Ames Lab., Ames, Iowa). [Oct. 18, 1962]. Contract [W-7405-eng-82]. 18p.

The separation of rare earths and Y from interfering elements was studied, and a method was proposed. Rare earths are precipitated as fluorides using CaF_2 as the carrier. Thorium and Zr are removed by extraction with thenoyltrifluoroacetone (TTA) in xylene at pH 1.3. Small amounts of residual Al and Fe are removed by extraction with 8-quinolinol–chloroform at pH 4.5. Rare earths are separated from Ca by TTA extraction at the same pH, and they are then back-extracted into 1 M HNO_3. After evaporation of the solution, the rare earths are determined spectrophotometrically with arsenazo. (P.C.H.)

23254 (PG-Report-220) ANALYTICAL METHOD FOR THE SPECTROGRAPHIC ANALYSIS (GENERAL METALS) OF URANIUM ORES AND CONCENTRATES BY THE CARRIER-DISTILLATION METHOD. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 24p.

The ore or concentrate after ignition is diluted with spectrographically pure U_3O_8 and mixed with 5% by weight of AgCl carrier. The mixture is placed in a graphite cup that is made the anode for excitation in a d-c arc at 10 to 12 amp. Spectra are recorded photographically using a large quartz spectrograph. The method is suitable for the low-level determination of As, Au, Be, Bi, Cd, Co, Cr, Cu, Ga, Ge, In, Mn, Ni, Pb, Sb, Sn, Tl, V, and Pd. Limits of detection and ranges of determination are dependent on the total impurity content of the ore or concentrate. (P.C.H.)

23255 (PG-Report-239) ANALYTICAL METHOD FOR THE GASOMETRIC DETERMINATION OF CARBON IN NIOBIUM METAL. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 13p.

Niobium metal in the form of swarf or powder, is ignited

with Pb as fluxing agent in an O_2 stream. The CO_2 evolved is isolated by means of a cold trap, cooled in liquid O_2, and is measured, after expansion at room temperature, as a gas volume. (auth)

23256 (PG-Report-437) THE ABSORPTIOMETRIC DETERMINATION OF IRON IN MAGNOX MN 70. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 5p.

A method is given for the determination of Fe in the range 20 to 300 ppm in Magnox MN 70. The alloy is dissolved in HCl and the Fe concentration is determined absorptiometrically as the thioglycollic acid complex. At the 180 ppm level the standard deviation is ±6 ppm. (P.C.H.)

23257 (PG-Report-438) ANALYTICAL METHOD FOR THE DETERMINATION OF TRI-ISO-BUTYL PHOSPHATE IN TRIBUTYL PHOSPHATE AND MIXTURES OF TRIBUTYL PHOSPHATE AND KEROSENE. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1963. 6p.

The sample is washed with sodium carbonate solution and with water. The absorption by the washed sample of radiation of wave number 880 cm^{-1} is measured and ascribed to a branched chain skeletal structure. The method was originally intended for the inspection of tributyl phosphate supplied as a raw material but may be applied to any mixture of tributyl phosphate and kerosene. (auth)

23258 (SC-4784(RR)) DETERMINATION OF CHROMIUM, COBALT, IRON, AND NICKEL IN ALLOYS. B. T. Kenna and F. J. Conrad (Sandia Lab., Albuquerque, N. Mex.). Apr. 1963. Contract [AT(29-1)-789]. 14p.

A procedure is given for the separation of Cr, Co, Fe, and Ni by utilizing anion exchange with HCl as an eluant. Quantitative determinations of the elements are made by standard methods. The procedure proved to be reliable and quantitative and may be used in conjunction with most alloys containing all or part of the elements. (P.C.H.)

23259 (USNRDL-TR-637) A METHOD FOR THE COLLECTION, STORAGE, AND MONITORING ANALYSIS OF NATURAL SEA WATER. H. Goya, P. Zigman, M. Lai, and J. Mackin (Naval Radiological Defense Lab., San Francisco). Feb. 27, 1963. Contract AT(49-5)-2084. 29p.

Natural seawater was required for use in experiments designed to determine the dissolution rate of certain nuclear fuel materials. A method was devised for the collection, storage, and analysis of the water. The method stipulates: off-shore collection of surface water in polyethylene carboys, which are subsequently stored, at a reduced temperature, in a dark location; and monitoring biological and chemical composition via microfiltration, chlorinity, oxygen, alkalinity, phosphate, and nitrate analyses. (auth)

23260 (AERE-Trans-933) X-RAY SPECTROSCOPIC ANALYSIS USING RADIOISOTOPES. S. Enomoto and C. Mori. Translated by E. H. M. Colegrave (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Genshiryoku Kogyo, 8: No. 7, 6-13(1962). 24p.

The use of radioisotopes for x-ray-spectroscopic measurements has developed from the use of relatively simple interactions, such as absorption and scattering of radiation by a substance. A review is given of radioisotopes and spectrometers in use. (auth)

23261 SPECTROCHEMICAL ANALYSIS OF RADIOACTIVE SUBSTANCES. I. MEASUREMENTS WITH ALTERNATING CURRENT ARC. V. Svoboda and V. Dedek (Research Inst. for Detection and Applications of Radioisotopes, Prague). Acta Chim. Acad. Sci. Hung., 32: 407-17 (1962). (In German)

Reproducibility and sensitivity of the arc method were studied, and the construction of a discharge chamber is described. With small sample size the atmosphere composition in the chamber is of critical importance. The dependence of discharge temperature on this composition was determined; the mean temperature of the plasma (in °K) for 5 gases was as follows: air 8300, oxygen 9550, nitrogen 8250, carbon dioxide 9050, and argon 9200. The highest rate of vaporization was obtained with oxygen, the lowest with argon. The background in the spectral range 2200 to 6000 Å was lowest with oxygen and argon. The discharge temperature was shown to be most important; small variations affected analytical reproducibility. With increasing sample size and decreasing ionization potential of the sample, the potential of the spark distance declined. Changes in the burning time half period were dependent on the burning potential of the arc and on the ionization potential. The lower limit of sensitivity of the method (in mμg) for various elements was as follows: Cu 0.7, Cd 20, Zn 100, Sr 0.5, In 5, K 300, Ca 600, Co 10, La 30, Mn 6, and Y 15. The mean error for a determination was ~30%. (TCO)

23262 THE SIMULTANEOUS DETERMINATION OF ATMOSPHERIC RADON BY FILTER PAPER AND CHARCOAL ADSORPTIVE TECHNIQUES. Bernard Shleien (Robert A. Taft Sanitary Engineering Center, Cincinnati). Am. Ind. Hyg. Assoc. J., 24: 180-7(Mar.-Apr. 1963).

A method is described for the simultaneous collection of Ra and its daughters from environmental air samples by a two-stage sampling device. The Ra daughter products are separated from the air stream by means of a membrane filter and Rn itself is then adsorbed on activated charcoal in the sampler's second stage. Subsequent to collection, Rn daughter activity is measured by α scintillation techniques, and gaseous Rn concentration is determined by γ spectrometry of the charcoal adsorption bed. Samples were taken under varying external environmental conditions, as well as indoors. Results are presented comparing atmospheric Rn concentrations determined by direct and filter paper techniques. (auth)

23263 OXYGEN FLASK METHOD FOR THE ASSAY OF TRITIUM-, CARBON-14-, AND SULFUR-35-LABELED COMPOUNDS. Horace E. Dobbs (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Anal. Chem., 35: 783-6(June 1963).

Solid samples weighed onto filter paper, and liquid samples injected into gelatin capsules, are burned in an oxygen-filled, round-bottomed, three-necked flask fitted with a rubber vaccine serum cap. After the combustion, which is triggered by an electric discharge, a liquid scintillator is injected into the flask. A liquid phosphor containing water is equilibrated with the radioactive water produced by burning tritiated materials. The gas produced by the combustion of C^{14} and S^{35} compounds is absorbed in liquid scintillator containing phenethylamine. Flushing the liquid phosphors with nitrogen gas, prior to counting, increases the counting efficiency for all three isotopes, and improves the reproducibility of the method for tritiated materials. The counting efficiency of the liquid phosphors is similar after the combustion of most compounds, but reduced efficiencies are observed when azo compounds are burned. (auth)

23264 DETERMINATION OF OXYGEN IN GALLIUM ARSENIDE BY NEUTRON ACTIVATION ANALYSIS. R. F.

Bailey and D. A. Ross (RCA Labs., Princeton, N. J.). Anal. Chem., 35: 791-4(June 1963).

Neutron activation of O in Ga arsenide was carried out using the $O^{16}(T, n)F^{18}$ reaction with the tritons being produced by the $Li^{6}(n, T)He^{4}$ reaction. The maximum sensitivity of the method is about 7×10^{-9} g of O in Ga arsenide, representing 5 atomic ppm in the samples used. The actual bulk concentration in the GaAs samples used was 72 ± 18 atomic ppm. (auth)

23265 SPECTROPHOTOMETRIC DETERMINATION OF NEPTUNIUM USING 1.23-MICRON SEXIVALENT ABSORPTION PEAK. Curtis A. Colvin (General Electric Co., Richland, Wash.). Anal. Chem., 35: 806-8(June 1963).

Neptunium at concentrations above 0.05 g/l may be determined rapidly with practically no interference from other ions. At ambient temperatures Np is oxidized by sexivalent Cr to the sexivalent state, which has an absorption peak at 1.23 microns. Beer's law is obeyed, and the method has a relative standard deviation of ±0.5% at 3 g/l. Use of a recording spectrophotometer enables quick detection of possible interference or incomplete oxidation in any sample. (auth)

23266 DETERMINATION OF TRACE QUANTITIES OF URANIUM BY NEUTRON ACTIVATION ANALYSIS. Dirk Decat, Benjamin Van Zanten, and George Leliaert (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). Anal. Chem., 35: 845-7(June 1963).

Trace quantities of U are determined in various substances such as clover (trifolium sp.), human urine, Al (housekeeping quality), and high purity Al. The method is based on the reaction $U^{238}(n, \gamma)U^{239}$ and measurement of the 74-kev line of U^{239}. As the half life of U^{239} is only 23 min, a fast chemical separation is necessary—the reasonably selective extraction of U from H_2SO_4 medium with tri-n-octylamine in kerosene. The detection limit for a separation time of 20 to 30 min is calculated to be about 5×10^{-11} g. (auth)

23267 CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF INDIUM. W. R. Mountcastle, Jr., W. D. Shults, and P. F. Thomason (Oak Ridge National Lab., Tenn.). Anal. Chem., 35: 871-4(June 1963).

A method was developed for the determination of In by controlled-potential coulometric titration. The method involves the coulometric reduction of In(III) to In(Hg) at −0.66 volt vs S.C.E. in 1M KCl−0.25M HCl medium. The relative standard deviation is about 0.1% and the relative error is 0.1 to 0.2% at the 5-mg level. Reasonable amounts of Fe(III), U(VI), Ni(II), and Co(II) do not interfere. The coulometric oxidation of the In(Hg) formed upon electrolytic reduction can also be used for quantitative measurement if it is advantageous to do so. Submilligram amounts of In can be determined in the same supporting medium by standard polarographic techniques: the i_d vs C relationship is linear over the 0.005 to 0.10 mg/ml concentration range. (auth)

23268 DETERMINATION OF SULFATE WITH CHROMIUM-51. W. J. Armento and C. E. Larson (Oak Ridge National Lab., Tenn.). Anal. Chem., 35: 918-20 (June 1963).

A procedure was developed for the determination of sulfate with Cr^{51}. The method involves the reaction in which the sulfate is precipitated with an excess of a HCl solution of $BaCrO_4$. After neutralization of the solution with ammonia, the insoluble $BaSO_4$ and excess $BaCrO_4$ are filtered off and the soluble chromate, equivalent to the sulfate originally present, is determined by redox titration. The excess is measured by first adding Cr^{51} trace to the $BaCrO_4$ solution and then measuring the activity of the excess chromate. With the use of Cr^{51}, the determination can be performed in the presence of substances that interfere with the normal redox titration procedure. (P.C.H.)

23269 CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF URANIUM(VI) IN URANIUM–NIOBIUM ALLOYS. W. D. Shults and Louise B. Dunlap (Oak Ridge National Lab., Tenn.). Anal. Chem., 35: 921-3 (June 1963).

Two procedures were developed, one in which U is determined in the presence of Nb and a second in which U is separated from Nb and then titrated. The first procedure can be used for fairly pure U–Nb solutions in which the Nb : U weight ratio is 3 : 1 or less. The second procedure is used for solutions containing Nb : U weight ratios greater than 3 : 1 or for solutions containing contaminants, such as Fe, that interfere in the subsequent U titration. Both methods are precise, accurate, and can be applied to the analysis of samples in which the Nb : U weight ratio is much greater than presently encountered dissolver solutions of this type. (P.C.H.)

23270 THE DETERMINATION OF URANIUM AND THORIUM IN ROCKS BY NEUTRON ACTIVATION ANALYSIS. J. W. Morgan and J. F. Lovering (Australian National Univ., Canberra). Anal. Chim. Acta, 28: 405-17(May 1963). (In English)

A neutron activation method is described for the determination of Th and U in rocks at the microgram and submicrogram levels. Radiochemical separations are carried out using the alpha-active nuclides Pa^{231} and Np^{237} as tracers. The method is applied to the standard granite G1 and the standard diabase W1. (auth)

23271 THE DIRECT FLAME PHOTOMETRIC DETERMINATION OF STRONTIUM : CALCIUM RATIOS IN THE ASH OF HUMAN BONES AND TEETH. M. S. W. Webb and M. L. Wordingham (Royal Arsenal, London). Anal. Chim. Acta, 28: 450-6(May 1963). (In English)

Samples of bone or tooth ash are dissolved in HCl and the Sr/Ca ratio is determined directly by flame photometry using an oxygen-propane flame, surrounded by a mantle of O in order to eliminate the suppressing effect of phosphate. The effective concentration range is 20 to 1000 ppm of Sr with respect to Ca and the standard deviation, which remains constant over this range, is 10 ppm of Sr with respect to Ca. (auth)

23272 A METHOD OF SEMIQUANTITATIVE PHOTOGRAPHIC β-RAY MEASUREMENT WITH THE RING OVEN TECHNIC. H. Weisz and D. Klockow (Universität, Freiburg i. B.). Anal. Chim. Acta, 28: 467-71(May 1963). (In German)

A method for the semiquantitative autoradiographic determination of radioisotopes by β-ray measurement is proposed. The techniques of ring-oven spot colorimetry are applied in a modified form and no special exposure device is needed. The occurrence of a fading effect and its avoidance are discussed. (auth)

23273 NEUTRON ACTIVATION DETERMINATION OF IMPURITIES CONTAINED IN ORGANIC COMPOUNDS USED IN NUCLEAR TECHNOLOGY. Jules Pauly and Francesco Girardi (Euratom, Ispra, Italy). Bull. Soc. Chim. France, No. 2, 244-7(Feb. 1963). (In French)

Impurities were determined in terphenyls and plastic materials by activation in a reactor. After homogenization of the product to be analyzed, samples were irradiated in the presence of standards of the elements to be detected or

of a neutron flux indicator. The short-lived activities from Cl, Mn, Cu, Na, and Br were identified and measured by gamma spectrometry and study of the decay. The radioisotopes with longer life were separated by analytical chemistry procedures after addition of carriers and oxidation of the organic material. (tr-auth)

23274 METHODS FOR THE DETERMINATION OF RADIOACTIVE STRONTIUM IN BIOLOGICAL SUBSTANCES. Lucien Jeanmaire and Georges Michon (CEN, Fontenay-aux-Roses, France). Bull. Soc. Chim. France, No. 2, 413-15(Feb. 1963). (In French)

The principal difficulties in the determination of radiostrontium in biological materials are the low radioactivities to be measured, the presence of other radioisotopes, and calcium. The techniques presently used for this determination can be divided into three groups: methods concentrating the strontium by precipitation, methods using ion exchange resins, and methods using solvent extraction. Techniques based on each of these methods are reviewed. (J.S.R.)

23275 RADIOMETRIC DETERMINATION OF THORIUM, URANIUM AND POTASSIUM IN BASALTS AND IN TWO MAGMATIC DIFFERENTIATION SERIES. Knut S. Heier and John J. Rogers (Rice Univ., Houston, Tex.). Geochim. Cosmochim. Acta, 27: 137-54(Feb. 1963). (In English)

Thorium, U, and K contents of basalts and other basic rocks were measured by gamma spectrometry. The ratios of Th/K, U/K, and Th/U are constant within one order of magnitude in a wide variety of rock types. The averages for basalts are: $Th/K \times 10^4 = 2.8$, $U/K \times 10^4 = 0.60$, and $Th/U = 4.8$. Some tendency exists, however, for increase in the ratios with igneous differentiation. The Th/U ratio is particularly low in tholeiites (1.6) from the orogenically active Japanese area and is also lower in the basic rocks of the Duluth and Southern California sequences than in most basalts. Apparently the process that leads to the formation of magma in orogenic areas causes removal of Th, K, and to a lesser extent, U from source materials before intrusion or eruption. Close relation between K content and Th/U ratio in basic rocks from widely separated areas, however, suggests that the subcrust in which basic magmas originate is compositionally uniform and differences between the compositions of primary basalt magmas are probably the result of local processes. (auth)

23276 THE DETERMINATION OF THORIUM AND URANIUM IN GEOLOGICAL SAMPLES BY AN ALPHA-COUNTING TECHNIQUE. R. D. Cherry (Univ. of Cape Town, Rondebosch, South Africa). Geochim. Cosmochim. Acta, 27: 183-9(Feb. 1963). (In English)

The use of a thick-source alpha-particle detection technique for the simultaneous determination of both Th and U in geological samples is discussed. The technique depends on the presence of the thorium pairs resulting from the successive decays of thoron and the short-lived isotope thorium A. The absolute accuracy, sensitivity, and limitations of the method are considered. Finally, Th and U determinations for the granites G-1 and Tory Hill and the diabase W-1 are presented. (auth)

23277 DETERMINATION OF IRON(II) IN THE PRESENCE OF URANIUM (IV) IN MINERALS. V. T. Athavale and P. Murugaiyan (Atomic Energy Establishment, Trombay, India). Indian J. Chem., 1: 67-9(Feb. 1963).

It is shown that the interference of uranium (IV) in the determination of iron (II) in minerals and ores could be removed by dissolution of the sample in phosphoric acid in the presence of which ferric iron is not reduced by uranium (IV). The ferrous iron can then be determined by titrating with standard potassium permanganate using methylene blue as indicator. The results obtained with various synthetic mixtures containing iron (II), iron (III), and uranium (IV) are presented. If uranium (VI) is present in a mineral, it interferes in the determination of iron (II) as it alters the ferrous iron content during dissolution itself. (auth)

23278 DETERMINATION OF MICRO AMOUNTS OF URANIUM USING CHROME AZUROL S AS A COLORIMETRIC REAGENT. Surendra Nath Sinha and Arun K. Dey (Univ. of Allahabad, India). Indian J. Chem., 1: 70-2 (Feb. 1963).

The formation of a blue-colored chelate (λ_{max} 585 mμ) between uranyl ion and 3″-sulpho-2″,6″-dichloro-3,3′-dimethyl-4-hydroxyfuchsone dicarboxylic acid (Chrome Azurol S; color index 723) was used for the colorimetric determination of uranium. The color is stable between pH 4.2 and 6.2, and measurements are possible over a wide range of temperature (up to 98°C). The system obeys Beer's law between 0.19 and 17.2 ppm of uranium. The sensitivity is 0.0238 γ/cm^2 (Sandell) and 0.238 γ/cm^2 (practical). Copper, beryllium, aluminium, iron, thorium, zirconium, carbonate, phosphate, borate, citrate, tartrate, and oxalate interfere in the determination at all concentrations. (auth)

23279 AN ALL-METAL SPECTROMETER FOR THE ISOTOPIC ANALYSIS OF HYDROGEN AT NATURAL CONCENTRATION LEVELS. P. V. Krishna Murthy and B. S. Prahallada Rao (Atomic Energy Establishment, Trombay, India). Indian J. Pure Appl. Phys., 1: 73-9(Feb. 1963).

The design and constructional details of an all-metal, double-collector type mass spectrometer, in which the pole faces form part of the analyzer, are described. The spectrometer has the advantage of ruggedness and easy demountability of the ion source for replacement of filament and for cleaning purposes. The design also provides a simple and perfect arrangement for shielding the electrometers and hi-meg resistors. A negative shield behind the filament in the ion source improves the efficiency of the ionizing electron beam. The use of normal slits instead of slant slits on the collector side leads to a reduction in the sizes of the collector slits and the collector cups, resulting in reduced pickups and easier mounting arrangement. The stabilities of H_3^+ formation and the operation of the instrument in the routine isotopic analysis of hydrogen over long periods are comparable to those of the existing glass spectrometers. With this instrument samples could be compared to a precision of 0.0001 mole per cent deuterium. Percentage differences of samples checked over an interval of 3-4 months were found to be reproducible to a precision of ±1 per cent. (auth)

23280 THE COUNTING OF NATURALLY OCCURRING RADIOCARBON IN THE FORM OF BENZENE IN A LIQUID SCINTILLATION COUNTER. C. Leger and M. S. Tamers (CEN, Saclay, France). Intern. J. Appl. Radiation Isotopes, 14: 65-70(Feb. 1963). (In English)

A counting system is described for C^{14} dating with a benzene scintillator solution. The single photomultiplier counter used is relatively simple and reliable. Different sizes and forms of the counting solution containers were investigated. A 6-ml cell with a background of 4.0 counts/min and a 45% detection efficiency is recommended for routine C^{14} dating. A 60-ml cell with a background of 14.6 counts/min and a 45% detection efficiency is capable of dating samples as old as 57,500 years (4 σ statistics, 48 hr counting). The

calibration and operation of the counter are discussed. On comparison with standard gas counter methods, it is suggested that routine C^{14} dating by the benzene method is preferable in those cases where the laboratory personnel are more skilled in chemical manipulations than electronic technique. (auth)

23281 ON THE IDENTIFICATION OF β-EMITTERS BY ABSORPTION MEASUREMENTS. L. Daddi and V. D'Angelo (CAMEN, Pisa, Italy). Intern. J. Appl. Radiation Isotopes, 14: 97-103(Feb. 1963). (In English)

A method is presented for the identification of pure β-emitters by the determination of the quantity $E^* = (E_0 + \bar{E})/2$ characteristic of each radionuclide. The quantity E^* is deduced from an empirical relation, $E^* = E^*(\mu)$, between the values of E^* and those of the absorption coefficients, μ, in gold or aluminum, as computed in the intermediate part of the transmission curve. (auth)

23282 ELEMENTARY ANALYSIS OF FLUORINE BY NEUTRON ACTIVATION. B. Van Zanten, D. Decat, and G. Leliaert (Studiecentrum voor Kernenergie, Mol, Belg.). Intern. J. Appl. Radiation Isotopes, 14: 105-11(Feb. 1963). (In English)

Activation analysis provides a handy tool for elementary fluorine determination, with a relative error of 1 to 2%. As fluorine standards, ammonium fluoride and p-fluorobenzoic acid can be used. The values obtained for the fluorine contents show a good reproducibility with platinum as flux monitor. As a result of the analyzing technique used, most interferences are negligible or can be eliminated, and the radiation damage can be restricted to a minimum so that in most cases the compound is not lost for further use. The method is applied to determine the changes in fluorine content of teflon by pile irradiation. (auth)

23283 ESTIMATION OF ZIRCONIUM BY ELECTROMETRIC METHODS. V. K. Sharma and J. N. Gaur (Univ. of Rajasthan, Jaipur, India). J. Electroanal. Chem., 5: 375-8(May 1963). (In English)

Potassium tellurite can be used to estimate zirconium in zirconyl chloride solutions by conductometric, potentiometric, and amperometric methods. For dilute solutions of zirconyl chloride, direct titration using a strong solution of potassium tellurite is suggested, whereas for strong solutions a reverse titration using a dilute solution of potassium tellurite and adding a strong solution of zirconyl chloride is recommended. (P.C.H.)

23284 MICRODETERMINATION AND SEPARATION OF CALCIUM AND STRONTIUM IN URINE. Hertha H. Taussky (Inst. of Muscle Disease, New York). Microchem. J., 7: 89-97(May 1963).

A method is presented for the determination and separation of calcium and strontium in urine. It is based on the different solubilities of the sulfates in weakly acid solution. The separation is accomplished by dissolving the combined oxalates in ammonium bisulfate and heating in a boiling water bath for 25 minutes. The specificity of the direct precipitation of calcium oxalate from urine is improved by a preliminary extraction with chloroform. A new wash liquid is introduced, a mixture of concentrated ammonia and glacial acetic acid, in which calcium and strontium oxalate are practically insoluble. The method is easily applied to serum and ash solutions of biological specimens. (auth)

23285 ACTIVATION ANALYSIS OF PAPER CHROMATOGRAMS FOR IODINE (IODINE-127 → IODINE-128). Alice Dimitriadou, P. C. R. Turner, and Russell Fraser (Postgraduate Medical School and the Medical Research Council Cyclotron Unit, London). Nature, 198: 576-7 (May 11, 1963).

Procedures for the activation analysis of paper chromatograms for the $I^{127} \rightarrow I^{128}$ reaction are discussed. Sodium-24 radioactivity induced in the paper was eliminated by distillation. (C.H.)

23286 RAPID DETERMINATION OF RUBIDIUM IN CAESIUM NITRATE BY NEUTRON ACTIVATION. Minoru Okada (Government Chemical Industrial Research Inst., Tokyo). Nature, 198: 577(May 11, 1963).

A procedure is described for the rapid determination of Ru in Cs nitrate by use of neutron irradiation followed by γ scintillation spectrometry. (C.H.)

23287 RADIOMETRIC TITRATION OF THE HEXACHLOROPLATINATE(IV) ION. A. T. Casey and W. Robb (Univ. of Melbourne). Nature, 198: 581-2(May 11, 1963).

A procedure is described for the radiometric titration of hexachloroplatinate(IV) ion in which the Cs in Cs_2PtCl_6 precipitate is labeled with Cs^{137} and the radioactivity of this isotope used as an indicator in a volumetric technique. (C.H.)

23288 POTENTIOMETRIC ACIDIMETRIC DETERMINATION OF ZIRCONIUM. D. Singh and V. S. Agarwala (Banaras Hindu Univ., India). Z. Anorg. Allgem. Chem., 321: 81-4(Mar. 1963). (In English)

The potentiometric acidimetric determination of zirconium is based on the interaction between its hydroxide and KF yielding hydroxide ions which are determined with standard HCl as titrant. This method is not suitable for the estimation of titanium. The presence of Be, Al, La, Th, and second group cations interfere. However, the presence of Cr, Ni, Co, Zn, and Mn even in larger quantities does not affect the accuracy of the results. The method is quick, simple, and specific and yields satisfactory results. (auth)

23289 RADIOACTIVE ISOTOPES IN ANALYTICAL CHEMISTRY. L. M. Mikheeva and N. B. Mikheev. Moscow, Gosatomizdat, 1961. 98p.

Topics discussed are: the use of radioactive indicators to determine the solubility of slightly soluble compounds; the use of radioisotopes to study the processes of coprecipitation and to develop gravimetric analysis methods; quantitative methods of chemical analysis based on the use of radioisotopes and radioactive radiations; and radioactive analysis. (OID)

Inorganic and Physical Chemistry

23290 (AAEC/TM-189) A 1620 FORTRAN PROGRAMME FOR THE REFINEMENT OF LATTICE PARAMETERS BY A MODIFIED LEAST SQUARES METHOD. D. G. Walker (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Apr. 1963. 11p.

An IBM-1620 program that calculates refined lattice parameters from x-ray diffraction data according to Hess's method is described. The program may be used for cubic, hexagonal, and tetragonal systems; and three systematic error functions are included. The output includes the refined parameters, their standard errors, and the misfit of the data at each experimental point. (auth)

23291 (BMI-X-10041) DEVELOPMENT OF URANIUM MONONITRIDE. Quarterly Progress Report, January–March 1963. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1963. Work Performed under

United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 18p. (EURAEC-651)

A study was made of the two-phase impurity inclusions that frequently appear in hot isostatically pressed UN but at a level not identifiable by x-ray analysis. It appears that the impurities are carried through the various processing steps, perhaps from the original U metal. Equilibrium compositions in the U_2N_3–UN_2 region were determined as a function of N pressure over a temperature range of 700 to 850°C. From these measurements the partial molar free energy of dissociation, the partial molar enthalpy, and the partial molar entropy were calculated. Studies were also made on the determination of uranium activity in UN, the U liquidus line in equilibrium with UN, and the vapor pressure of UN. In UN melting studies, consumable arc-melting techniques show considerable promise for producing high-quality UN specimens. A UN specimen was tested for measuring the compositional changes that occur as a result of thermal gradients. Specimens were also prepared for UN compatibility studies in Na-K, H_2O, and terphenyl and against stainless steel, Zircaloy-2, and Al. (P.C.H.)

23292 (IS-518) SELF-DIFFUSION IN POLYCRYSTALLINE YTTRIUM OXIDE. Michael F. Berard and D. R. Wilder (Ames Lab., Ames, Iowa). [July 24, 1962]. Contract [W-7405-eng-82]. 18p.

The self-diffusion coefficient of Y in yttrium oxide was determined for polycrystalline Y_2O_3 in the temperature range 1400 to 1800°C. Radioactive Y^{91} was deposited on sintered specimens of 94 to 97% theoretical density. The specimens were annealed under vacuum and sectioned. The following equation describes the temperature dependence of the diffusion coefficient over the range studied: $D = 2.41 \times 10^{-4} \exp(-43{,}900/RT)$ cm^2/sec. (auth)

23293 (IS-533) VAPORIZATION REACTIONS OF VANADIUM(III) BROMIDE. DISSOCIATION AND DISPROPORTIONATION EQUILIBRIA, AND THE FORMATION OF VANADIUM(IV) BROMIDE. Robert E. McCarley and James W. Roddy (Ames Lab., Ames, Iowa). Aug. 21, 1962. Contract [W-7405-eng-82]. 29p.

The equilibria (1) $VBr_3(s) = VBr_2(s) + \frac{1}{2}Br_2(g)$ and (2) $2VBr_3(s) = VBr_2(s) + VBr_4(g)$ were studied over the range 644 to 805°K by transpiration in He. The expressions $\log p_{mm}(Br_2(g)) = -5070/T + 5.02$ and $\log p_{mm}(VBr_4(g)) = -8240/T + 8.47$ were derived from the measurements for (1) and (2), respectively; for (1) $\Delta H^0 = 23.1 \pm 0.9$ kcal/mole and $\Delta S^0 = 9.8 \pm 0.4$ eu, while for (2) $\Delta H^0 = 37.7 \pm 1.3$ kcal/mole and $\Delta S^0 = 25.5 \pm 0.8$ eu. Both transpiration in Br vapor and static pressure measurements using a glass diaphragm gauge showed the $VBr_3(s)$ vaporized as $VBr_4(g)$ in the presence of Br according to (3) $VBr_3(s) + \frac{1}{2}Br_2(g) = VBr_4(g)$. Data from the transpiration and diaphragm gauge measurements were in excellent agreement; the transpiration measurements gave for (3) $\log K_p(atm^{-\frac{1}{2}}) = -3455/T + 5.22$ and $\Delta F^0 = 15.80 \times 10^3 - 23.9T$ for T = 515 to 585°K. Solid VBr_4 was isolated by condensation of the vapor at –78°C, and was found to be stable at –45°C. At higher temperatures the solid decomposed to $VBr_3(s)$ and Br. (auth)

23294 (IS-534) THE VAPOR PRESSURES OF VCl_2, VCl_3, VBr_2 AND VBr_3 BY KNUDSEN EFFUSION. R. E. McCarley and J. W. Roddy (Ames Lab., Ames, Iowa). Aug. 21, 1962. Contract [W-7405-eng-82]. 21p.

The vapor pressures of crystalline VCl_2, VBr_2, VCl_3, and VBr_3 were measured by the Knudsen effusion method using pyrex and Vycor effusion cells. The equations $\log p(mm) = -9804/T + 8.713$ and $\log p(mm) = -10460/T + 9.081$ were obtained for the vapor pressures of VCl_2 and VBr_2, respectively, over the range 750 to 950°K. Expressions derived for the standard heats and entropies of vaporization, respectively, are 44.8 kcal and 26.6 eu for VCl_2, and 47.8 kcal and 28.3 eu for VBr_2. During the measurements on VCl_3 and VBr_3, dissociation and disproportionation of the samples occurred simultaneously with the simple vaporization. However, because the product of each of the processes was collected separately during an experiment, the vapor pressure due to sublimation was obtained without difficulty. Results of the measurements were $\log p(mm) = -9777/T + 11.20$, $\Delta H^\circ = 44.7$ kcal, and $\Delta S^\circ = 38.0$ eu for vaporization of VCl_3 over the range 625 to 740°K. For VBr_3, $\log p(mm) = -9470/T + 11.12$, $\Delta H^\circ = 43.3$ kcal, and $\Delta S^\circ = 37.7$ eu were obtained over the range 590 to 700°K. (auth)

23295 (IS-535) TRANSPORT REACTIONS OF SOME VANADIUM(III) HALIDES. MIXED HALIDE FORMATION. Robert E. McCarley, James W. Roddy, and Keith O. Berry (Ames Lab., Ames, Iowa). [Aug. 21, 1962]. Contract [W-7405-eng-82]. 24p.

The reactions of VCl_2, VCl_3, and VCl_3–VBr_3 mixtures with Br vapor at 350 to 450°C led to vaporization of the halides and deposition of mixed halides of vanadium(III) at lower temperatures. A study of solid solution formation in the system VCl_3–VBr_3 showed that the two components were miscible in the solid state, and that the mixed halide VCl_2Br should be regarded as such a solid solution. The pure compounds VCl_3 and VBr_3, the mixed halides VCl_2Br and VBr_2I, and solutions of all compositions in the system VCl_3–VBr_3 were hexagonal solids with the BiI_3 layer structure; lattice constants for all of the compounds are given. Vaporization of VBr_2 in iodine vapor at 350 to 400°C resulted in the transport and deposition of VBr_2I, but the analogous reaction between VCl_2 and I yielded only a deposit of VCl_2. Vanadium(IV) mixed halides containing I were postulated to account for the vaporization at these temperatures. (auth)

23296 (IS-543) RARE EARTH METAL–METAL HALIDE SYSTEMS. LANTHANUM, CERIUM, AND PRASEODYMIUM BROMIDES. Robert A. Sallach and John D. Corbett (Ames Lab., Ames, Iowa). [Sept. 4, 1962]. Contract [W-7405-eng-82]. 12p.

The MBr_3 + M phase diagrams for La, Ce, and Pr are presented. Lanthanum and Ce exhibit simple solutions of metal, with 14 and 12 mole % dissolved in eutectic temperatures of 728 and 687°C, respectively. The compound $PrBr_{2.38}$ is found, melting incongruently to a solution of 16% Pr in $PrBr_3$ and Pr(s) at 601°. For Pr the cryoscopic behavior of dilute solutions of metal is consistent with the primary formation of the Pr^{3+} solute. But with La and Ce the results are anomalous, as the cryoscopic analyses indicate 1.6 to 1.7 and 2.0 new particles (cation basis) per metal dissolved instead of ~3. (auth)

23297 (IS-544) THE PREPARATION AND PROPERTIES OF NIOBIUM(IV) COMPOUNDS. I. NIOBIUM(IV) BROMIDE AND PYRIDINE ADDUCTS OF THE NIOBIUM(IV) HALIDES. Robert E. McCarley and Bruce A. Torp (Ames Lab., Ames, Iowa). [Sept. 5, 1962]. 36p.

Reaction of $NbBr_5$ and Nb metal in a sealed tube under a temperature gradient from 410 to 350°C gave $NbBr_4$ in good yields. However, an increase in the higher temperature from 410 to 450°C was sufficient to eliminate $NbBr_4$ as a product and cause deposition of a lower bromide. The halides $NbCl_4$ and $NbBr_4$ are isomorphous solids of orthorhombic structure and lattice constants a = 8.12, b = 8.88,

c = 6.84 Å and a = 8.60, b = 9.31, c = 7.19 Å, respectively; both solids are diamagnetic over the range −196 to 25°. Formation of the tetrahalodi(pyridine)niobium(IV) complexes resulted from the reactions of the pure tetrahalides (Cl, Br, I) with pyridine at room temperature; at elevated temperature a second form of $NbBr_4py_2$ crystallized from pyridine. Evidence bearing on the structure of the pyridine adducts was obtained from conductance, spectral, and magnetic susceptibility measurements. The complexes are paramagnetic and exhibit moments much lower than the spin only value for one magnetic electron; the spectra of solutions in pyridine show intense bands in the visible region which were attributed to charge transfer transitions. (auth)

23298 (LADC-5488) THE APPLICATION OF HIGH-SPEED COMPUTERS TO THE LEAST-SQUARES TREATMENT OF KINETIC DATA. R. H. Moore and T. W. Newton (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract W-7405-eng-36. 6p.

Some applications of high speed computers to least-squares calculations on non-linear equations that arise in the treatment of kinetic chemical data are discussed. The particular examples considered are the least-squares determination of the activation parameters for the reactions between U(IV) and Fe(III) and between U(IV) and Pu(VI). Values obtained for the parameters agree well with other determinations, but the estimates of the precision differ by about a factor of two. A non-linear least-squares program has also facilitated the routine calculation of apparent second order rate constants from spectrophotometric data. (D.C.W.)

23299 (MLM-987) THE VAPOR-LIQUID EQUILIBRIUM OF DILUTE SOLUTIONS OF POLONIUM IN LIQUID BISMUTH. E. F. Joy (Mound Lab., Miamisburg, Ohio). Sept. 5, 1954. Contract AT(33-1)-Gen-53. 29p.

The vapor-liquid equilibrium of dilute solutions of Po in liquid Bi was determined from 450 to 850°C. The relative volatility of liquid Po–Bi mixtures was determined by the Langmuir and Knudsen methods. Equations are presented for the vapor pressure of Bi and the volatility and activity coefficient of Po. (P.C.H.)

23300 (NAA-SR-8085) MAGNETIC SUSCEPTIBILITIES OF MOLTEN Bi–BiI_3 SOLUTIONS. L. E. Topol and L. D. Ransom (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 31, 1963. Contract AT(11-1)-Gen-8. 25p.

Magnetic susceptibility measurements were made with a Gouy balance on molten Bi–BiI_3 solutions at 450 to 600°C over the entire composition range. The susceptibilities were diamagnetic throughout and were found to become less diamagnetic as temperature increased. The temperature dependence varied with concentration of Bi and was greatest in the 30 to 70 mole % Bi solutions. The molar susceptibility as a function of mole fraction of Bi showed slight deviations from simple additivity in a diamagnetic direction in the salt-rich region and larger deviations from additivity in a paramagnetic direction in the metal-rich melts. The magnetic behavior is discussed in terms of possible chemical species as well as the free electron model. (auth)

23301 (NASA-TN-D-1791) TABULATED VALUES OF BOND DISSOCIATION ENERGIES, IONIZATION POTENTIALS, AND ELECTRON AFFINITIES FOR SOME MOLECULES FOUND IN HIGH-TEMPERATURE CHEMICAL REACTIONS. Charles J. Schexnayder, Jr. (National Aeronautics and Space Administration. Langley Research Center, Langley, Field, Va.). May 1963. 62p.

Values of bond dissociation energies, ionization potentials, and electron affinities are tabulated for some monatomic, diatomic, and polyatomic molecules, which are found in many high-temperature chemical reactions including combustion reactions. 113 references are given to journals and books published since 1950. (P.C.H.)

23302 (NAVWEPS-7227) A SURVEY OF BERYLLIUM CHLORIDE–ETHER AND BERYLLIUM CHLORIDE–AMINE COMPLEXES. F. E. Brinckman, Jr., N. R. Fetter, and F. M. Peters (Naval Ordnance Lab., Corona, Calif.). Aug. 15, 1962. 20p.

A study was made of the reactions of $BeCl_2$ with tertiary amines and diethyl ether and of the exchange reactions of the complexes formed. The study led to the preparation of several hitherto unreported compounds: $BeCl_2$–etherate, a $BeCl_2$–pyridinate, and a $BeCl_2$–trimethylamine complex. The nitrogen base complexes decompose in a reaction previously unknown in Be chemistry. Elemental analyses, molecular weight data, infrared spectra, and NMR spectra are presented. (auth)

23303 (NP-12672) CINETICA DE OXIDACION DE UO_2 EN AIRE. Informe No. 74. (Kinetics of the Oxidation of UO_2 in Air. Report No. 74). Carlos Aráoz (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1962. 28p.

Thermal differential analyses were made of the oxidation in air of uranium dioxide powder between 25 and 600°C. The two characteristic exothermal peaks were obtained. The first corresponds to the diffusion-controlled reaction $UO_2 \rightarrow UO_{2.3}$ at 210°C. The second corresponds to $UO_{2.3} \rightarrow U_3O_8$, a nucleation and rupture process of the powder grains. There is a small intermediate peak that is attributed to thermal inhomogeneities of the system. Contrary to reports cited in the literature, nonstoichiometric oxides are not shown by this method although they are more susceptible to oxidation than the stoichiometric oxides. A marked effect on the oxidation-reduction cycle is, however, noticed. Powders with different initial oxygen concentrations, O/U ratio from 2.02 to 2.37, show a variation of the height of the first peak with the oxygen concentration. The second peak remains constant. The O/U vs. height graph of the first peak indicates a shift toward compositions of the order of 2.25, which is interpreted as the appearance of the orthohombic phase. A new method for the calibration of the curves in calories is tested and heat quantities agreeing with those given in the literature for the reaction are obtained. (tr-auth)

23304 (TID-16263) SOME INFLUENCES DETERMINING COORDINATION NUMBER OF CATIONS. Leonard I. Katzin (Argonne National Lab., Ill.). May 1962. Contract [W-31-109-eng-38]. 6p. (UAC-6462)

Octahedral and tetrahedral coordination are discussed with some references to linear, square planar, and more complicated high-coordinations situations. The coordination states assumed by a cation are a function both of the orbitals available to the cation and the bonding characteristics of the ligand. One important characteristic of the ligand seems to be the energy of the bond formed with the cation, and the determination of the equilibrium cation coordination represents a balance of the energies of six groups bound with a lesser unit energy, and four groups bound with a greater. The equilibrium is set by the magnitude and direction of the difference in the several cases. (P.C.H.)

23305 (TID-16914) IODINE VAPOR–SILVER NITRATE REACTION MECHANISMS AND PHASE EQUILIBRIA. J. W. Lacksonen, W. H. Kirby, and C. E. Dryden

(Ohio State Univ., Columbus). Oct. 1962. Contract [AT (11-1)-750]. 17p.

The reaction of I_2(v) with $AgNO_3$(s or l) produced AgI and $AgIO_3$ in different ratios depending on temperature and ambient gas composition. A reaction mechanism via the INO_3 intermediate is proposed. Silver iodate was proved stable in the presence of $AgNO_3$ and AgI up to at least 320°C. A temperature–composition diagram was prepared for the ternary $AgI-AgIO_3-AgNO_3$ with the lowest melting point eutectic at 76°C and a corresponding composition of 50% AgI–23% $AgIO_3$–27% $AgNO_3$. (auth)

23306 (TID-18635) THERMAL STUDIES OF THE PLASTIC CRYSTAL TRANSITION IN SUCCINONITRILE. Claus A. Wulff and Edgar F. Westrum, Jr. (Michigan. Univ., Ann Arbor. Dept. of Chemistry). 1963. Contract AT(11-1)-1149. 17p.

The heat capacity of succinonitrile was determined by adiabatic calorimetry between 5 and 350°K. Crystal II is stable below 233°K, at which temperature it undergoes an isothermal transition to solid Crystal I with enthalpy and entropy increments of transition of 1482 cal/mole and 6.35 cal/(mole °K). The latter value is in accord with a statistically calculated value of 6.39 cal/(mole °K). Crystal I melts at 331.30°K at one atmosphere and under its own vapor pressure at 331.16°K with enthalpy and entropy increments of fusion of 885 cal/mole and 2.68 cal/(mole °K). An analysis of the heat capacity of Crystal II permitted evaluation of the spectroscopically unobserved torsional frequency as 136 ± 6 cm^{-1}. The standard entropy of the vapor at 298.15°K was computed by a third-law path as 79.04 cal/(mole °K) and spectroscopically as 79.09 cal/(mole °K); the agreement constitutes a third-law verification. Thermodynamic functions were evaluated for the condensed phases by integration of the heat capacity data and are, for Crystal I at 298.15°K, in units of cal/(mole °K): $\underline{C}_p$ = 34.80, $\underline{S}^0$ = 45.79, $(\underline{H}^0-\underline{H}_0^0)/\underline{T}$ = 24.35, and $-(\underline{F}^0-\underline{H}_0^0)/\underline{T}$ = 21.44. (auth)

23307 (UCRL-10702) THE ACTIVATION ENERGY FOR THE SUBLIMATION OF GALLIUM NITRIDE (thesis). Zuhair A. Munir (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 14, 1963. Contract W-7405-eng-48. 48p.

Mass-spectroscopic measurements were used to demonstrate that Ga vaporizes almost exclusively as Ga atoms, and that Ga nitride vaporizes as Ga atoms and Ni molecules. The vapor pressure of Ga was measured by the torsion-effusion method between 1174 and 1603°K. The pressure, in atmospheres, is given by the expression: $\log P = 5.458 - (13{,}743/T)$ in that temperature range. The heat of sublimation of Ga was calculated by the second-law method to be 63.5 kcal/mole when extrapolated to 298°K, while the value calculated by the third-law method is 65.44 ± 0.23 kcal/mole. The rate of the reaction $GaN(s) \rightarrow Ga(g) + \frac{1}{2} N_2(g)$ was measured by a torsion-Langmuir method. Heats of activation were calculated to be ΔH_{298} = 125.4 kcal/mole and ΔH_{298} = 127.50 kcal/mole by the second-law and third-law methods, respectively. Entropies of the slow step were found to be ΔS_{298} = 54.85 eu by the second-law method and ΔS_{298} = 52.92 eu by the third law method. The close agreement in these values implies that the rate-determining step is the final step of escape of Ga or Ni molecules from the surface, rather than an earlier surface diffusion step. It is proposed that the slow step is the formation and immediate desorption of N molecules from the surface. (P.C.H.)

23308 (UCRL-10717) LIQUID-LIQUID INTERFACIAL-TENSION MEASUREMENT WITH AN OSCILLATING JET. Alfred E. Vandegrift, Peter N. Tenney, and Theodore Vermeulen (California. Univ., Berkeley. Lawrence Radiation Lab., and California. Univ., Berkeley). Mar. 11, 1963. Contract W-7405-eng-48. 102p.

The oscillating-jet technique, used for some time to measure both the static and dynamic surface tension between a gas and a liquid, was extended to the measurement of the interfacial tension between two immiscible liquids. Both a theory and experimental techniques were developed. This work was undertaken in order to obtain a method of studying interfacial concentrations in liquid-liquid systems undergoing mass transfer. The mathematical derivation given is an extension of Bohr's theory for the gas-liquid case. However, since this theoretical treatment required as its input the velocity profile of the oscillating jet, an average profile was solved for in the case of a circular liquid-liquid jet. The extension of Bohr's mathematics with the incorporated velocity profile gave a mathematical expression that calculates the interfacial tension to within 25% of the actual value in most cases; a large part of the observed deviation is believed to be experimental. Data were taken on immiscible-liquid pairs whose interfacial tension ranges from 6 to 42 dyn/cm. Experimental techniques are described for preparing the elliptical nozzles, illuminating the jet properly, and measuring the wavelength of oscillation. It was found that the best methods for preparing nozzles for liquid-gas systems do not give the best nozzles for liquid-liquid systems. The lighting and measuring techniques are different from those used in liquid-gas systems, because of the different range of refractive-index ratio in two-liquid systems. (auth)

23309 NEUTRON DIFFRACTION STUDY OF MAGNESIUM DEUTERIDE. W. H. Zachariasen (Univ. of Chicago), C. E. Holley, Jr., and J. F. Stamper, Jr. Acta Cryst., 16: 352-3(May 10, 1963). (In English)

A magnesium deuteride preparation of composition $Mg(D_{0.9}H_{0.1})_2$ is found to be tetragonal with a = 4.5025, c = 3.0123 Å. The atomic positions are: 2 Mg in (000) ($\frac{1}{2}\frac{1}{2}\frac{1}{2}$), 4(D + H) in ± (xx0) ($\frac{1}{2}$ + x, $\frac{1}{2}$ – x, $\frac{1}{2}$) with x = 0.306 ± 0.003. The bond lengths are Mg–6D = 1.95 ± 0.02 Å. The structure is of the rutile type. (auth)

23310 THE CRYSTAL STRUCTURE OF $Cu_{0.65}NbS_2$ AND SOME RELATED COMPOUNDS. K. Koerts (Universiteit, Leiden). Acta Cryst., 16: 432-3(May 10, 1963). (In English)

Unit cell parameters were determined as follows: $Cu_{0.65}NbS_2$, a = 3.35 Å and c = 13.13 Å; $Ag_{0.7}NbS_2$, a = 3.35 Å and c = 14.46 Å; and $Cu_{0.65}NbSe_2$, a = 3.47 Å and c = 13.53 Å. Diffraction line intensities of $Cu_{0.65}NbS_2$ were calculated on the basis of a space group $P6_3mmc$ and found to agree well with observed intensities. (D.L.C.)

23311 EFFECT OF CARBON MONOXIDE IN CAUSING NONUNIFORM GASIFICATION OF GRAPHITE BY CARBON DIOXIDE. L. G. Austin and P. L. Walker, Jr. (Pennsylvania State Univ., University Park). A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 9: 303-6(May 1963).

Existing theories on the effect of mass transport on the rate (uniformity) of chemical reaction within a porous solid assume that the reaction is of integer order. However the carbon-carbon dioxide reaction has the kinetic rate form, $\text{rate} = k_1\rho_{CO_2}/(1 + k_2\rho_{CO} + k_3\rho_{CO_2})$. For conditions where the retarding effect of carbon monoxide is very pronounced, the buildup of small concentrations of carbon monoxide within the porous graphite can lead to appreciable nonuniformity of gasification. Thus the criteria normally used to predict uniformity of gasification break down. A numerical integration of the combined differential equation of

mass transport and chemical reaction was performed, with rate constants for the carbon-carbon dioxide reaction taken from the literature. The results indicate that extreme nonuniformity of reaction can exist even when the change in carbon dioxide concentration from the exterior of the sample to the interior is small. The results are similar to experimental determinations of nonuniformity of gasification, obtained by determining the porosity of reacted graphite samples as a function of depth from the reacting face. Experimentally nonuniformity of reaction was observed for gasification rates a hundredfold lower than the usual Thiele criteria would predict, probably because of carbon monoxide inhibition. (auth)

23312 CATHODIC ACTION OF THE URANYL-LACTATE COMPLEX AT THE DROPPING MERCURY ELECTRODE. Tsai-teh Lai and Bi-cheng Wang (Cheng Kung Univ., Taiwan, China). Anal. Chem., 35: 905-8(June 1963).

The complex of U with lactic acid was studied polarographically. The limits of reversibility and complexation, which are the function of pH and the concentration of lactic acid, are shown. $E^{1}/_{3}$ $E^{7}/_{8}$ are first used in deriving an equation for studying a polynuclear complex. Partial polymerization to form a dimer takes place in the reduced form of the complex. The complex forms and electrode reactions in various given ranges of pH value and concentration of complexing agent are proposed. (auth)

23313 PARAMAGNETIC RESONANCE OF Yb^{3+} IN YTTRIUM OXIDE. Morton Mandel (General Telephone and Electronics Labs., Inc., Palo Alto, Calif.). Appl. Phys. Letters, 2: 197-8(May 15, 1963).

The ground-state properties of Yb^{3+}-doped yttrium oxide were investigated by means of paramagnetic resonance techniques. For a general orientation of the d-c magnetic field, 10 resonance lines were observed. For the magnetic field confined to the (110) plane, 7 lines were observed. The absorption spectrum at 4.2°K as a function of magnetic field orientation in the (110) plane for a 0.5% Yb concentration is presented. (C.E.S.)

23314 KINETIC STUDY OF THE NITRATION OF URANIUM POWDER. Claude Moreau and Joseph Philippot (CEN, Grenoble, France). Bull. Soc. Chim. France, No. 2, 283-9(Feb. 1963). (In France)

The kinetics of the nitration of uranium powder by nitrogen and ammonia were studied. The grains were spherical and of the same dimension. The Valensi-Carter formula was used to characterize an initial step and a final diffusion step. An intermediary step appears to obey a linear law: in reality, it is probably a case of diffusion across a film of constant thickness. The calculated activation energy is in agreement with this hypothesis. (tr-auth)

23315 DEVELOPMENT OF A CHEMICAL PROCESS FOR PRODUCTION OF CESIUM CHLORIDE FROM A CANADIAN POLLUCITE ORE. H. W. Parsons, J. A. Vezina, R. Simard, and H. W. Smith (Dept. of Mines and Technical Surveys, Ottawa). Can. Met. Quart., 2: 1-13 (Jan.-Mar. 1963).

A chemical process was developed for the production of a high-purity cesium chloride from a pollucite (cesium aluminum silicate) ore from the Manitoba deposit of Chemalloy Minerals Ltd. The history of the deposit, and the present and possible future uses of cesium are briefly reviewed. Laboratory and pilot plant investigations on this ore have shown that a cyclic sulphuric acid leach followed by fractional crystallization will produce a rubidium-free cesium alum, which can be converted to cesium chloride by thermal decomposition and ion exchange. On the basis of these findings it is concluded that the process is applicable to the tonnage production of cesium chloride. Reagent consumption was found to be 3.3 sulphuric acid and 0.3 lb hydrochloric acid per pound of cesium extracted. Overall extraction of cesium was 95 to 96%. (auth)

23316 PLUTONIUM—ITS CHEMICAL AND PHYSICAL PROPERTIES. Ansgar Schiffers. Chemiker-Ztg., 86: 656-70(Sept. 20, 1962). (In German)

A brief review is given of the chemical and physical properties of Pu. The topics discussed are the occurrence and preparation of the metal, isotopes and alloys, chemical properties, and analytical chemistry. A tabulation is made of the principal compounds and their properties and preparation. 260 references. (J.S.R.)

23317 THE GRAVIMETRIC STANDARDS UO_2 AND U_3O_8 USED IN THE URANIUM–OXYGEN SYSTEM. Paul Gerdanian and Maurice Dode (Faculté des Sciences, Paris). Compt. Rend., 256: 2182-3(Mar. 4, 1963). (In French)

The behavior of uranium oxides at 800° in air and at 900° in hydrogen was studied with a thermobalance. The variations of the composition of the oxide could be followed without tempering or manipulation of the product. The starting material was natural uranium with an impurity rate below 173×10^{-6}. The uranium was oxidized in air at 800°C, the product was reduced in dry hydrogen at 900°, and the oxide was reoxidized in air at 800°. The composition of the oxides was calculated using 238.038 as the atomic weight of U. The results showed that the compound obtained by direct oxidation of U in air is slightly deficient in oxygen with respect to U_3O_8. The reduction product is not deficient in oxygen with respect to UO_2, and it is a good gravimetric standard. The product obtained by oxidation of oxides of the UO_{2+x} phase in air at 800°C is stoichiometric U_3O_8. (J.S.R.)

23318 REACTIONS OF ATOMIC HYDROGEN ON H_2S AND D_2S. Guy Pannetier, Pierre Goudmand, Odile Dessaux, and Nicole Tavernier (Laboratoire de Chimie Générale du Centre, Orsay, France). Compt. Rend., 256: 2854-7(Mar. 25, 1963). (In French)

The flame spectra of H_2S and D_2S with atomic hydrogen were studied. Some known bands of the systems $^3\Sigma_u^- — ^3\Sigma_g^-$ of S_2 and $^2\Sigma — ^2\pi$ of SH were present. Some unknown emissions were attributed to S_2 and S_n. The observation of levels higher than 9 for $S_2(^3\Sigma_u^-)$ is explained by a preassociation mechanism beginning with sulfur atoms in the ^3P state. (tr-auth)

23319 PYROLYSIS OF N_3H AND N_3D IN SHOCK WAVES. OBSERVATIONS OF TWO NEW BANDS OF THE ND RADICAL. Guy Pannetier, Pierre Goudmand, Odile Dessaux, and Henri Guénebaut (Faculté des Sciences, Paris and Faculté des Sciences, Reims). Compt. Rend., 256: 3082-5(Apr. 1, 1963). (In French)

The passage of a shock wave in hydrazoic acid is accompanied by a very intense luminescence which was analyzed by cinematography and spectroscopy. A recording camera established the propagation velocity of the incident wave and showed discontinuous luminous phenomena that are produced following the incident wave. The total duration of the luminosity after passage of the wave is 2.5×10^{-2} sec. The spectrum of the shock wave, measured for a pressure ratio ~300, showed two new transitions when Q branches degraded toward the red were measured at 3391.1 Å (29,480 cm^{-1}) and 3398.7 Å (29,414 cm^{-1}). (tr-auth)

23320 THERMOLUMINESCENT DOSIMETRY WITH LiF FOR RADIATION THERAPY AND RADIATION PROTECTION CONTROL. L. Herforth and M. Frank (Tech-

nische Universitat, Dresden). Czech. J. Phys., 13: 219-21 (1963). (In German)

The preparation of LiF for thermoluminescent dosimetry is reported. The dosimetric properties of LiF are given and the future application of this procedure in practice is discussed. (auth)

23321 THE THERMAL STABILITY OF ScF_3 AND ITS REACTION WITH MgF_2. L. N. Komissarova and B. I. Pokrovskii (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 149: 599-601(Mar. 21, 1963). (In Russian)

ScF_3 was prepared by reacting Sc_2O_3 with 40% HF, and MgF_2 was prepared by reacting $MgCO_3$ with 40% HF. A thermogravimetric analysis showed that ScF_3 begins to lose weight slowly at about 400°C; the weight loss becomes much more rapid at 650°C. The ScF_3 is directly converted to Sc_2O_3 without formation of an intermediate oxyfluoride. The rate of conversion of ScF_3 to Sc_2O_3 depends on the temperature. Complete conversion takes 2.5 hours at 900°, 5.3 hours at 800°, and 11 hours at 700°C. It was found that ScF_3 melts at a temperature of 1530 ± 20°C, and undergoes a polymorphic conversion at 1350°C. The phase diagram of the ScF_3–MgF_2 system was determined. The solubility of ScF_3 is about 5 mol % in MgF_3. A eutectic is formed at 34 mol % ScF_3. The melting point of the eutectic is 1095°C. No formation of intermediate phases in the system were observed. The lattice parameters of MgF_2 (a and c) are 4.613 and 3.081 kX, respectively, which decrease to a = 4.595, and c = 3.041 kX on adding ScF_3 to the MgF_2. (TTT)

23322 THE STRUCTURE OF A RADIOACTIVE PRECIPITATE. V. V. Gromov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 149: 626-8(Mar. 21, 1963). (In Russian)

Radioactive precipitates of BaS^*O_4, $CaS^*O_4 \cdot 2H_2O$, $Ca^*SO_4 \cdot 2H_2O$ and SrS^*O_4 were formed at 70°C by mixing equivalent amounts of the chloride salt (1.0 to 2.0 N) with a Na_2SO_4 solution. S^{35} and Ca^{45} were used as the radioactive isotopes. The surface area of the precipitate decreased up to a specific activity of 1.0 mc/g, and then increased sharply, especially for the difficultly-soluble precipitate of $BaSO_4$. The surface area of the radioactive precipitate did not change with time on storage in air (up to one year). An analysis of the distribution of particle sizes showed that the radioactive precipitate becomes more nonuniform with increasing specific activity, especially above 1 mc/gram. At 100 mc/g, the particles not only become smaller, but there is also a tendency to form particles of two different sizes. This phenomenon can be explained by the fact that more centers of crystallization tend to form in the presence of radioactivity, and also by the fact that radioactive precipitates tend to recrystallize and grow faster than nonradioactive precipitates. This hypothesis will be tested by preparing nonradioactive precipitates with external irradiation. These precipitates should have a higher surface area than nonradioactive precipitates prepared in the usual manner. (TTT)

23323 THE HOMOGENEOUS AND HETEROGENEOUS CRYSTALLIZATION OF CARBON. V. I. Kasatochkin and G. B. Finkel'shtein (Inst. of Fossil Fuels, USSR). Dokl. Akad. Nauk SSSR, 149: 629-32(Mar. 21, 1963). (In Russian).

Various cokes can be homogeneously converted to graphite at temperatures above 2000°K. This is a monomolecular reaction with a high activation energy of ~92 kcal/g-atom. Amorphous and crystalline carbon phases do not co-exist during homogeneous crystallization, and the formation of strong lateral bonds of the type = C = C = C = slows down the homogeneous crystallization with the appearance of intermediate forms of crystalline carbon. On the other hand, all carbonaceous materials undergo a heterogeneous conversion to graphite characterized by the co-existence of amorphous carbon and crystalline carbon. Heterogeneous crystallization is observed in sugar carbon at the relatively low temperature of ~700°K, and is believed to be due to the catalytic decomposition of gaseous CO on the crystallite centers. Thus, oxygen can carry carbon to the crystallite centers in the form of a gas. An x-ray analysis of an 0.8 g sample of sugar carbon calcined at 800°K showed an increase in intensity of the d_{002} line of the graphite layers. A 22 gram sample calcined at 1000 to 3300°K in an argon atmosphere showed an even greater increase in crystallinity. As the calcining temperature is increased from 2370 to 3070°K, the carbon crystallites attain a relatively high degree of three-dimensional order due to the elimination of rotational defects above 2200°K. It is concluded that heterogeneous crystallization takes place by precipitation of crystalline carbon from the gas phase, and is accompanied by a process of homogeneous crystallization. More crystallinity is observed at all calcining temperatures in products of heterogeneous crystallization than in products of homogeneous crystallization. (TTT)

23324 POLONIUM. K. W. Bagnall (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Endeavour, 22: 61-4(May 1963). (In English)

The historical background of Po is discussed. The health hazards of Po and some of the necessary equipment for handling it are described. The radiation effects and chemistry of Po are discussed in some detail. A table of the Po compounds and some of the ways in which they are formed is given. Some applications of Po are described briefly. (D.L.C.)

23325 SYNTHESIS AND PROPERTIES OF MEAN AND BASIC CERIUM ORTHOPHOSPHATES. A. I. Ulyanov and T. I. Kazakov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Otd. Khim. Nauk, No. 3, 393-401(Mar. 1963). (In Russian)

A new preparation method was suggested for $CePO_4 \cdot XH_2O$ (x = 1.5 to 2.0), and basic cerium phosphates 9 $CePO_4 \cdot Ce(OH)_3 \cdot XH_2O$ (x = 22 to 35) were synthesized. Properties of synthesized compounds (filtrability, density, thermal behavior, refractive index, specific weight, structure, solubility and solubility in concentrated acids) were studied. (R.V.J.)

23326 STABILITY OF COMPLEX COMPOUNDS OF LANTHANUM, PRASEODYMIUM AND NEODYMIUM WITH GLYCINE. I. M. Batyaev and S. V. Larionov (Novosibirsk Inst. of Inorganic Chemistry, Academy of Sciences, Siberian SSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 12, 69-74(1962). (In Russian)

Primary stability constants for La and Pr complexes with glycine and primary and secondary constants for neodymium-glycine complexes were determined. The stability of the complex compounds increased from La to Nd. The stability of rare earth compounds (La, Ce, Pr, and Nd) with aspartic acid is higher than with glutaric acid or glycine. (R.V.J.)

23327 INVESTIGATIONS OF AN ISOTOPIC EFFECT IN OZONE THERMAL DECOMPOSITION. I. A. Tikhomirov and V. N. Melenevskii (Tomsk Polytechnic Inst., USSR). Izv. Sibirsk. Otd. Akad. Nauk SSSR, No. 12, 131-3(1962). (In Russian)

The isotopic effect in electrical production of ozone was

studied by determining the diffusion coefficient in the reverse process, thermal decomposition. A strong ozone enrichment in O^{18} was observed during the thermal decomposition. The thermal decomposition coefficient was 1.08 ± 0.01. An absence of isotopic exchange between ozone and oxygen was noticed during the thermal decomposition at 120°C. The thermal diffusion coefficient was 1.07 at 120°C. (R.V.J.)

23328 HYDROGEN ISOTOPE FRACTIONATION IN ACIDIFIED SOLUTIONS OF PROTIUM AND DEUTERIUM OXIDE. A. J. Kresge (Illinois Inst. of Tech., Chicago) and A. L. Allred. J. Am. Chem. Soc., 85: 1541(May 20, 1963). (TID-17991)

Preliminary results are reported for a nuclear magnetic resonance method used to measure directly the equilibrium constant $K = ([D^+(D_2O)_n][H_2O]^{(2n+1)/2})/([H^+(H_2O)_n][D_2O]^{(2n+1)/2})$. K values were calculated for a number of integral values of q, the number of hydrogens in the solvated proton aggregate (2n + 1). The value of q with the smallest spread in $l = K^{1/q}$ is 4, with 3 not much worse, and l = 0.67. (D.L.C.)

23329 POLAROGRAPHIC BEHAVIOUR OF TECHNETIUM. G. B. S. Salaria, Charles L. Rulfs, and Philip J. Elving (Univ. of Michigan, Ann Arbor). J. Chem. Soc., 2479-84(Apr. 1963).

The electrochemical reduction of pertechnetate ion and related species was examined polarographically and by macroscale electrolysis, including coulometry, over the pH range of –0.6 to 13.30. Technetium(VII) is reduced in two or three stages. In acidic media the first stage usually involves addition of four electrons, giving technetium(III); a poorly separated (IV) → (III) step is sometimes discernible. In non-complex-forming media of pH > 4, the first stage of reduction proceeds only to technetium(IV); in macroscale electrolyses this product is largely precipitated as TcO_2. Subsequent reduction is quite profound, equivalent at least to the level of metallic technetium, and the complex nature of this stage may justify the postulation of technetium hydrides analogous to rhenium hydrides analogous to rhenium hydrides. In solutions of pH 11 to 13 the reduction step of technetium(IV) to metal (?) breaks into two stages, an adsorption-controlled (IV) → (III) step preceding further reduction. (auth)

23330 DIAGRAM OF STATE AND THERMODYNAMIC PROPERTIES OF PURE ISOTOPES AND OF ISOTOPIC SOLUTIONS. André Bellemans (Université Libre, Brussels). J. Chim. Phys., 60: 23-8(Jan.-Feb. 1963). (In French)

The variation of the residual energy at absolute zero with the molecular mass is the principal cause of differences appearing in the diagrams of state of pure isotopes of the same chemical constituent. Each isotope can be characterized by the quantum parameter Λ (introduced by Boer) that represents, in fact, a reduced de Broglie wavelength. A quantum generalization of the classical theorem of corresponding states permits the experimental results to be interpreted and coördinated. It is necessary to take into consideration a very slight modification of the intermolecular forces with the passage of one isotopic molecule to another. Completely negligible for light isotopes (He and H_2), this effect can be dominant for heavy isotopes (h-cyclohexane and d-cyclohexane). With respect to solid and liquid isotopic solutions, studies made by statistical mechanics indicate a positive excess free energy g^E and, consequently, a demixture at sufficiently low temperature. Experimentally, it was found that $g^E > 0$ for the liquid solutions He^3-He^4, H_2-D_2, and H_2-HD and for the solid solution H_2-D_2. The only known example of isotopic demixture at the present is given by the system He^3-He^4. (tr-auth)

23331 ISOTOPE EFFECTS IN PHASE EQUILIBRIA. Giovanni Boato (Università, Genoa). J. Chim. Phys., 60: 44-7(Jan.-Feb. 1963). (In English)

Experimental and theoretical values of the logarithm of the isotope separation factor for several simple systems are given as a function of temperature. The agreement between theory and experiment is satisfactory for both solid and liquid inert gas systems. (auth)

23332 ON THE RELATION BETWEEN ISOTOPE EFFECTS ON VAPOR PRESSURE AND MOLECULAR STRUCTURE. István Kiss, Lajos Matus, and István Opauszky (Central Research Inst. for Physics, Budapest). J. Chim. Phys., 60: 52-5(Jan.-Feb. 1963). (In English)

A comparative analysis of available experimental data of the isotope effects on the vapor pressure of polyatomic liquid compounds is given. As a common basis for comparison the reduced temperature scale is used. The variations in the vapor pressure ratio with the reduced temperature have a nearly identical shape for isotopic substitutions of the same character in the same radicals of different compounds or in compounds having identical structures. For some groups of compounds a linear relationship is found between the isotopic effects related to the same value of the reduced temperature scale and the reciprocal square roots of the molecular weights. (auth)

23333 ISOTOPIC FRACTIONATION DURING DISTILLATION OF WATER. Liliane Merlivat, René Botter, and Guy Nief (CEN, Saclay, France). J. Chim. Phys., 60: 56-9(Jan.-Feb. 1963). (In French)

The isotopic fractionation factor during distillation of water was determined in the temperature range between the triple point and the critical point. The results obtained were compared with those calculated using the geometric mean rule. Some deviations were observed. (tr-auth)

23334 THE RELATION OF VAPOR PRESSURES IN THE SYSTEMS $C^{12}H_4/C^{13}H_4/C^{12}H_3D$, $N^{14}_2O/N^{15}N^{14}O$, $S^{16}O_2/S^{18}O_2$, AND Ar^{36}/Ar^{40}. Klaus Clusius, Kuno Schleich, Fritz Endtinger, Robert Bernstein, and Manfred Vogelmann (Universität, Zurich). J. Chim. Phys., 60: 66-9(Jan.-Feb. 1963). (In French)

Exact measurements of differences of vapor pressure on different high-percentage isotopic gases between the melting point and the boiling point showed a contribution by the mass distribution in the molecule to the vapor pressure. This contribution is independent of an immediate mass effect. Moreover, the effect of the association of the liquid phase on the difference of vapor pressure was discussed. For explanation of large isotopic effects, the quantitative thermodynamic relations between the entropy of evaporation and the heat of association evidently play a determinant role. (tr-auth)

23335 CATALYSIS OF ISOTOPIC EXCHANGE IN NITRIC OXIDE. Fritz S. Klein, William Spindel, and Marvin J. Stern (Weizmann Inst. of Science, Rehovoth, Israel and Rutgers Univ., Newark, N. J.). J. Chim. Phys., 60: 148-53(Jan.-Feb. 1963). (In English)

The rate of isotopic exchange in nitric oxide was studied over the temperature range –80 to +125°C, using a mass spectrometer to measure the intensity of the $N^{15}O^{18}$ peak when $N^{14}O^{18}$ and $N^{15}O^{16}$ samples are mixed. Exchange does not take place in rigorously purified nitric oxide samples, but is catalyzed by small amounts of nitrogen dioxide. The rate constants of the exchange at –80 and +125°C are both lower than the value at 23°C. (auth)

23336 THE DETERMINATION OF THE QUANTUM MECHANICAL DIFFRACTION EFFECTS OF THERMAL DIFFUSION. A. I. Ghozlan and J. Los (FOM, Laboratorium voor Massascheiding, Amsterdam). J. Chim. Phys., 60: 178-82(Jan.-Feb. 1963). (In English)

In order to investigate the influence of diffraction effects on the thermal diffusion factor at low temperatures a two-bulb apparatus was used, of which the upper reservoir was maintained at a constant temperature, the room temperature T_h, while the temperature of the lower reservoir was varied from room temperature down till 12°K. The mixtures used were helium with tracer amounts of the tritium compounds T_2, DT and HT, and H_2 with tracer amounts of HT. The measurements showed a big influence of the diffraction effects on the thermal diffusion factor, especially at those temperatures where the De Broglie wavelength of the particles becomes of the same order as the diameter. There is a pronounced difference between the thermal diffusion factor $\alpha_{T2\text{-}He}$, where both particles may be diffusion factors of the other mixtures, where the symmetry is disturbed by the mass distribution in the molecule. A comparison with theory could not be made, because no calculations were available for the quantum parameters of the mixtures we used. (auth)

23337 PHOTOCHEMICAL OXIDATION OF MERCURY AND ISOTOPIC SELECTIVITY. Monique Desnoyer, Guy Nief, and Etienne Roth (CEN, Saclay, France). J. Chim. Phys., 60: 209-11(Jan.-Feb. 1963). (In French)

Oxidation of mercury vapor by different reagents, stimulated by 2537 Å wavelength radiation produced by an electrodeless mercury tube, was studied by determination of the quantity of the mercury oxide formed and by isotopic analysis of the mercury. Experiments were made on mixtures of mercury, water vapor, oxygen, and butadiene. It was shown that two distinct types of oxidation coexist. One is isotopically selective and the other, which is blocked by butadiene, is not. Moreover, the results seem to show that the first stage of the reaction is the formation of an excited associated state, such as $[HgO_2]^*$ or $[HgH_2O]^*$. (tr-auth)

23338 CONTINUOUS MEASUREMENT OF THE ISOTOPIC EFFECT IN THE REDUCTION OF CUPROUS OXIDE BY THE MIXTURE $C^{12}O-C^{14}O$. Jacques Richard, Paul Bussière, and Stanislas-Jean Teichner (Faculté des Sciences, Lyon and Institut de Recherches sur la Catalyse, Lyon). J. Chim. Phys., 60: 230-4(Jan.-Feb. 1963). (In French)

The reaction $Cu_2O + CO \rightarrow 2\,Cu + CO_2$ has complex kinetics, having a germination period for the copper followed by a period of decreasing velocity. The study of the kinetic isotopic effect was undertaken in order to determine if there is an observable variation in these two periods. Carbon monoxide containing $C^{14}O$ was used in the study, and gas circulation permitted the CO_2 to be continuously trapped and measured as it was formed. The activity of the radiocarbon was detected with a plastic scintillator and the pressure of the $C^{12}O$ on the cathetometer. The kinetic isotopic effect calculated from experimental results, either from the transformation rate as a function of time or from instantaneous velocities, seems constant for the process. (tr-auth)

23339 ION EXCHANGE IN SALTS AND MOLTEN METALS. Alfred Klemm (Max-Planck-Institut für Chemie, Mainz). J. Chim. Phys., 60: 237-44(Jan.-Feb. 1963). (In German)

The isotope effects on ion exchange in solid and molten salts and molten metals is discussed. The effect is described in relation to experience on the diffusion and conductivity of the material concerned. (tr-auth)

23340 MEASUREMENTS OF ISOTOPE ELECTROMIGRATION IN METALS. A. R. E. Lodding (Chalmers Tekniska Högskola, Göteborg). J. Chim. Phys., 60: 254-8(Jan.-Feb. 1963). (In English)

The isotope effect of electric current in molten metals (Haeffner-effect) was investigated, with special care taken to avoid the influence of convective mixing. Results are presented for pure Rb, K, and In, within wide ranges of temperature. The mass-effect μ of isotope electromigration is of the order 10^{-5} and grows approximately with the cube of absolute temperature. The light isotopes migrate towards anode. The effect was also measured in a molten Rb–K alloy at temperatures above and below the melting point of pure K. The mass-effect was greater for K, smaller for Rb than in pure metals. This is thought to be connected with electrolytic de-mixing with K transported towards anode. An isotope effect by electromigration was also found in solid In. At a temperature close to the melting point, the mass-effect was of the order of 10^{-8}, and the light isotope migrated towards cathode, i.e., opposite to the effect in melts. According to theory, the corresponding ion self-transport number U should be of the order 10^{-7}. This was confirmed by a direct measurement of U. (auth)

23341 THE CHEMISTRY OF PROTACTINIUM. I. THE NATURE OF SPECIES IN HCl SOLUTIONS BY SOLVENT EXTRACTION AND PAPER ELECTROPHORESIS. J. Shankar, K. S. Venkateswarlu, and C. Gopinathan (Atomic Energy Establishment, Trombay, India). J. Inorg. Nucl. Chem., 25: 57-66(Mar. 1963).

Experiments on the extraction of Pa^{233} into tri-n-butyl phosphate from hydrochloric acid solutions are described. The effect of fluoride, phosphate, citric, lactic, and tartaric acids on the distribution coefficient was studied. Ethyl acetoacetate was found to be a good extracting agent. A semi-closed type apparatus was designed for use in electrophoresis studies of Pa^{233} in HCl solutions. From the variation of the anion/cation ratio with the concentration of HCl, the nature of the cation-to-anion conversions could be inferred. The mobility of Pa^{233} is greatly enhanced by the presence of traces of fluoride ion, and the histograms clearly indicate the presence of cationic species. (auth)

23342 THE REACTION OF ZIRCONIUM HALIDES WITH SOLUTIONS OF POTASSIUM AND POTASSIUM AMIDE IN LIQUID AMMONIA. M. Allbutt and G. W. A. Fowles (Univ. of Southampton, Eng.). J. Inorg. Nucl. Chem., 25: 67-74(Mar. 1963).

Conductiometric titrations showed that the reaction of zirconium(IV) bromide with potassium amide in liquid ammonia corresponds to a final molar ratio $ZrBr_4 : KNH_2 = 1.0 : 6.0$. Three products were characterized, zirconium imide, $Zr(NH)_2$, mono-potassium ammonozirconate, $Zr(NH)(NK)$, and di-potassium ammonozirconate, $Zr(NK)_2{,}2NH_3$. In the reaction of zirconium(IV) bromide with potassium solutions, the end point occurred at a molar ratio $ZrBr_4 : K = 1.0 : 4.5$. For the reaction of zirconium(III) bromide with potassium amide a molar ratio $ZrBr_3 : KNH_2 = 1.0 : 3.5$ was found. An intermediate product containing zirconium in the average oxidation state of +3.5 is proposed. (auth)

23343 RUTHENIUM(VIII) IN NITRIC ACID. M. Shiloh and M. Givon (Israel Atomic Energy Commission, Rehovoth). J. Inorg. Nucl. Chem., 25: 103-8(Mar. 1963).

Absorption spectra of solutions of RuO_4 in nitric acid

were measured and electromigration experiments performed. From these experiments it is concluded that no charged species are formed. The distribution coefficient of RuO_4 between nitric acid and CCl_4 and kerosene was measured, but attempts to explain quantitatively the salting behavior by applying McDevit and Long's theory were unsuccessful. Approximate values of the thermodynamic quantities for extraction into CCl_4 were calculated, and activity coefficients were obtained from solubility data. A method for selective extraction of ruthenium from mixtures such as fission products by oxidation with sodium hypochlorite and extraction into kerosene is indicated. (auth)

23344 THE STRUCTURES OF $ZnLiVO_4$ AND $ZnLiNbO_4$. G. Blasse (Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). J. Inorg. Nucl. Chem., 25: 136-7(Mar. 1963).

$ZnLiVO_4$ has phenacite structure with a = 14.18 Å and c = 9.486 Å. This phenacite phase was transformed into a spinel phase by a pressure of 30 kb for 32 hr at 400°C, and the spinel phase has a cation arrangement of $V[LiZn]O_4$ and a cell edge of 8.309 Å. The densities of the phenacite and spinel phases were calculated to be 3.39 and 4.34, respectively. $ZnLiNbO_4$ appears to have a tetragonally deformed spinel structure with a = 8.602 Å and c = 8.402 Å, and a cation arrangement of $Zn[LiNb]O_4$. The superstructure reflection intensities agree with a model in which Li–Nb–Li–Nb sequences occur in the [110] and [$\bar{1}$10] rows and Li–Li–Nb–Nb sequences occur in the [101], [$\bar{1}$10], [011], and [0$\bar{1}$1] rows. (D.L.C.)

23345 ION-EXCHANGE PROPERTIES OF ZIRCONYL PHOSPHATES. PART III. INFLUENCE OF TEMPERATURE ON TRACER ION EQUILIBRIA. L. Baetslé (CEN, Mol, Belgium). J. Inorg. Nucl. Chem., 25: 271-82(Apr. 1963).

The influence of temperature on the ion exchange reactions of zirconyl phosphate in the H^+ form with Rb, Cs, Ca, Sr, Ce, and Eu was studied. It appears that Rb and Cs are very strongly adsorbed at room temperature but easily eluted at 80 to 100°C. The other nuclides investigated do not show such properties. The thermodynamic quantities ΔG, ΔH, and ΔS of the reactions are derived and throw some light on the exchange mechanism of the different ions studied, particularly of the alkali metal ions. (auth)

23346 AQUEOUS SYSTEMS AT HIGH TEMPERATURE. VIII. THE SOLUBILITY OF UO_3 HYDRATES IN HNO_3–H_2O SOLUTIONS, 25-350°C, 10^{-4}-6 MOLAL NITRATE. William L. Marshall and Ruth Slusher (Oak Ridge National Lab., Tenn.). J. Inorg. Nucl. Chem., 25: 283-90(Apr. 1963).

The solubility of UO_3 hydrates in HNO_3–H_2O solutions in the presence of the vapor was determined at temperatures from 25 to 350°C and at concentrations of total nitrate varying from 10^{-4} to 6 molal. The saturation molal ratios, $\underline{m}_{UO_3}:\underline{m}_{N_2O_5}$, were found to decrease from 2.6 to 0.32, from 1.60 to 0.72, and from 1.20 to 1.04 in 0.0015, 0.15, and 3.0 molal N_2O_5 solutions, respectively, as the temperature was increased from 25 to 350°. In application, the solubilities may be used to define hydrolysis equilibria and to specify phase stable, aqueous homogeneous-reactor fuels. Some acidities at 25° of unsaturated solutions of $UO_2(NO_3)_2$, HNO_3, and H_2O are included. (auth)

23347 THE EXTRACTION OF LITHIUM CHLORIDE BY TRI-N-BUTYL PHOSPHATE. D. F. C. Morris and E. L. Short (Brunel Coll., London). J. Inorg. Nucl. Chem., 25: 291-301(Apr. 1963).

The extraction of lithium chloride from aqueous solutions by tri-n-butyl phosphate (TBP) was investigated. Lithium chloride in the organic phase behaves as an associated electrolyte with a dissociation constant $\sim 5 \times 10^{-6}$. It is shown that up to ca. 0.96 M LiCl in the organic phase there is no strong TBP-salt interaction but there appears to be a definite tendency for the extracted lithium chloride to possess a primary hydration number of four. At higher concentrations, TBP molecules begin to substitute for H_2O molecules in the solvation shell of the extracted LiCl but a total solvation number of four seems to be maintained. Physical properties suggest the possibility of aggregation in the most concentrated extracts. (auth)

23348 CRYSTAL STRUCTURE OF THORIUM PERCHLORATE TETRAHYDRATE BY X-RAY METHOD. P. Rama Murthy and C. C. Patel (Indian Inst. of Science, Bangalore). J. Inorg. Nucl. Chem., 25: 310-12(Apr. 1963).

$Th(ClO_4)_4 \cdot 4\,H_2O$ was prepared by dissolving $Th(OH)_4$ in 1:4 mole ratio, evaporating the solution, recrystallizing the crystals from 0.2 N $HClO_4$, and drying over P_2O_5 under vacuum. The x-ray-diffraction pattern was determined and compared with that calculated for the orthorhombic system. The unit cell parameters are a = 4.44 A, b = 16.51 A, and c = 11.35 A, and the space group $P2_12_12$. (D.L.C.)

23349 THE PREPARATION AND PROPERTIES OF PERTECHNETYL FLUORIDE, TcO_3F. H. Selig and J. G. Malm (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 25: 349-51(Apr. 1963). (TID-17150; UAC-6737). (In English)

Pertechnetyl fluoride, TcO_3F, was prepared for the first time in gram quantities by the reaction of fluorine with TcO_2 at 150°C. Its properties are intermediate between those of MnO_3F and ReO_3F. It is a yellow solid which melts at 18.3°C to a yellow liquid. The vapor-pressure is represented by the following equations: Solid (–8.78 to 18.28°C): $\log_{10} p = 12.448 - (3239.4/T)$; Liquid 18.28 to 51.82°C): $\log_{10} p = 8.417 - (2064.6/T)$. The boiling point extrapolated from vapor-pressure measurements is about 100°C. TcO_3F is stable at room temperature and can be stored in nickel of monel containers. It is hydrolysed by water to pertechnetic and hydrofluoric acids. (auth)

23350 THERMODYNAMICS OF SOLUTION OF SOME INNER COMPLEX SALTS. [PART] II. M. M. Jones, A. T. Davila, J. E. Hix, Jr., and R. V. Dilts (Vanderbilt Univ., Nashville). J. Inorg. Nucl. Chem., 25: 369-75(Apr. 1963). (In English)

The solubilities of chromium(III) acetylacetonate, uranyl acetylacetonate monohydrate, and the uranyl oxinate complex containing an additional molecule of oxine were determined in several solvents over a range of temperatures. These solutions appear to conform approximately to Hildebrand's criteria for regular solutions. The solubility parameters of these complexes were evaluated, and the thermodynamic functions for the solution processes were calculated. The constancy of the solubility parameters toward various solvents suggests the possibility of prediction of the solubilities of these materials in non-polar solvents. The molal volumes of solutions of some highly symmetrical octahedral complexes in benzene are found to be represented very accurately by a linear equation in terms of mole fraction. The prediction of solubility parameters from the structural features of the inner complex salts is possible by the extension of Small's procedure for organic compounds. (auth)

23351 HALIDE COMPLEXES OF THE LANTHANIDE ELEMENTS. G. R. Choppin and P. J. Unrein (Florida State Univ., Tallahassee). J. Inorg. Nucl. Chem., 25: 387-93(Apr. 1963). (In English)

The stability constants for formation of $CeCl^{2+}$, $CeBr^{2+}$, $EuCl^{2+}$, $EuBr^{2+}$, EuI^{2+}, YCl^{2+}, and YBr^{2+} were measured at an ionic strength of 1.0 M by a liquid cation exchanger extraction method. Constants for formation of $CeCl_2^+$, $EuCl_2^+$, and $EuBr_2^+$ are also reported. The enthalpy and entropy values indicate that these complexes are ionic and possibly of the outer sphere type. (auth)

23352 AMMONIUM URANATES AND UO_3-HYDRATES-AMMONIATES. M. E. A. Hermans and T. Markestein (Keuring van Electrotechnische Materialen, N. V., Arnhem, Netherlands). J. Inorg. Nucl. Chem., 25: 461-2(Apr. 1963). (In English)

It is shown that a series of compounds of so-called ammonium uranates may occur, depending on the method of preparation, and that at least some ammonium uranates are in fact $UO_3 \cdot (2-x)H_2O \cdot xNH_3$. The reaction of gaseous or dissolved NH_3 with 0.15 to 0.60 M uranyl nitrate gives three products α, β, and γ, with transition points at pH 3 and 9, respectively. Their x-ray diagrams suggest that NH_3 replaced H_2O in the lattice instead of being present as NH_4^+. A reactive $UO_3 \cdot 2H_2O$ was prepared by electrolysis of the amorphous product from the urea process and washed with dry liquid NH_3 or H_2O. NH_3 washing gave a compound ϵ, while H_2O washing gave δ with some β. These compounds were found to be (β) $UO_3 \cdot {}^5/_6H_2O \cdot {}^1/_6NH_3$, ($\delta$) $UO_3 \cdot {}^3/_2H_2O \cdot {}^1/_2NH_3$, and ($\epsilon$) $UO_3 \cdot {}^4/_3H_2O \cdot {}^2/_3NH_3$. The reaction of dry gaseous NH_3 and $UO_3 \cdot 2H_2O$ also gave a series of compounds. The factors affecting the formation of the compounds are discussed. (D.L.C.)

23353 ISOTOPE EXCHANGE STUDIES ON THE URANIUM(VI) OXIDE HYDRATES AND URANIUM PEROXIDE. Frank D. Lonadier and James E. Boggs (Univ. of Texas, Austin). J. Less-Common Metals, 5: 112-16 (Apr. 1963). (In English)

The exchange of oxygen between water enriched in O^{18} and $UO_4 \cdot 2H_2O$, two crystalline forms of $UO_3 \cdot 2H_2O$, and three crystalline forms of $UO_3 \cdot H_2O$ was investigated. The results support the formulation of the peroxide as uranyl peroxide dihydrate, $UO_2(O_2) \cdot 2H_2O$, and are compatible with nuclear magnetic resonance studies on β-$UO_3 \cdot 2H_2O$ and β-$UO_3 \cdot H_2O$. The α- and β-forms of the UO_3 dihydrate are actually different substances rather than simply different crystalline modifications, and the same is true of the γ-monohydrate as contrasted with the α- and β-monohydrates. (auth)

23354 HYDROLYTIC SPLITTING OF THE HIGHER OXIDES OF PRASEODYMIUM AND TERBIUM. G. Brauer and B. Pfeiffer (Universität, Freiburg i. B.). J. Less-Common Metals, 5: 171-6(Apr. 1963). (In German)

The reaction between the oxides of praseodymium or terbium with an oxidation state of the metal M between III and IV and water leads by disproportionation to the hydroxide $M(OH)_3$ and the dioxide MO_2. The reaction with the praseodymium oxides proceeds slowly at 20°C and fast at 100°C; with the terbium oxides, a temperature of 200°C is required. The pure dioxides PrO_2 and TbO_2 may be prepared easily by treating the reaction products with suitable acids, which do not attack the dioxides. (auth)

23355 THE HEATS OF FORMATION OF TANTALUM CARBIDES. Elmer J. Huber, Jr., Earl L. Head, Charles E. Holley, Jr., and Allen L. Bowman (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 67: 793-6(Apr. 1963). (LADC-5464)

Heats of combustion in an oxygen bomb calorimeter were measured for Ta metal and a series of Ta carbides, TaC_x, where x varied from 0.485 to 0.998. Heats of formation were calculated. The values found for the heats of formation of Ta_2C, TaC, and Ta_2O_5 were -47.2 ± 3.4 kcal/mole, -34.6 ± 0.9 kcal/mole, and -487.7 ± 0.9 kcal/mole, respectively. (auth)

23356 REDUCTION OF URANIUM TRIOXIDE BY NITROGEN–HYDROGEN MIXTURE. V. G. Vlasov and V. M. Zhukovskii (Karpov Ural Polytechnic Inst., USSR). Kinetika i Kataliz, 4: 76-81(Jan.-Feb. 1963). (In Russian)

Kinetics of uranium trioxide reduction by nitrogen-hydrogen mixture at 350 to 500°C and 25 to 600 mm Hg was investigated. The activation energy of the process was 26.5 to 31.7 kcal/mole. The data were compared with the uranium trioxide reduction by pure hydrogen and ammonia. (tr-auth)

23357 PARAMAGNETIC DEFECTS IN γ-IRRADIATED AMMONIUM HYPOPHOSPHATE. J. R. Morton (National Research Council, Ottawa). Mol. Phys., 6: 193-9(Mar. 1963).

Radiation damage to the hypophosphate ion $P_2O_6^{4-}$ resulted in trapping in the crystal lattice of the radical $(O_2P-PO_3)^{3-}$, the EPR spectra of which were interpreted in terms of hyperfine interaction with both phosphorus nuclei. On heating the crystal to about 120°C the P–P bond of the trapped species breaks, the products being PO_3^{2-} and (presumably) PO_2^-. (auth)

23358 PHOTOELECTRIC EMISSION OF THE COMPLEXES BETWEEN CAESIUM AND POLYCYCLIC AROMATIC COMPOUNDS. Hiroo Inokuchi and Yoshiya Harada (Tokyo Univ.). Nature, 198: 477-8(May 4, 1963).

An investigation was made of the photovoltaic behavior under illumination by visible light of the interlayer junctions between cesium and polycyclic aromatic hydrocarbons. A photocell used to make a complex between alkali metal and aromatics and to observe photoemission is described and illustrated. The spectral response of the photoelectric quantum yield in electrons/quantum was determined for violanthrene-cesium complex. Similar photoelectric behavior was found for photocells of isoviolanthrone-cesium and pyranthrone-cesium. Reaction mechanisms involved are discussed. (C.H.)

23359 CONCERNING THE REACTIONS OF NEPTUNIUM DIOXIDE WITH ALKALINE EARTH OXIDES. Cornelius Keller (Technische Hochschule, Karlsruhe, Ger. and Kernreaktor Bau- and Betriebs GmbH, Karlsruhe, Ger.). Nukleonik, 5: 89-93(Apr. 1963). (In German)

The thermal double decomposition of NpO_2 with alkaline earth oxides under oxidizing, neutral, and reducing conditions was studied. In the systems $CaO-NpO_2$, $MgO-NpO_2$, and $BeO-NpO_2$ neither the formation of a compound nor a solid solution appeared. In the systems $BaO-NpO_2-O_2$ and $BaO-NpO_2$ the following ternary oxides could be prepared: $Ba(NpO_2)O_2$ ($a = 5.730 \pm 0.004$Å; $b = 8.089 \pm 0.007$Å; $c = 8.167 \pm 0.007$Å); Ba_3NpO_6 ($a = 8.860 \pm 0.005$Å); $BaNp_2O_7$; $BaNp_2O_{5.1 \pm 0.2}$ (fluorite phase, $a = 5.437 \pm 0.005$Å); and $BaNpO_3$ ($a = 4.384 \pm 0.006$Å). In the systems $SrO-NpO_2-O_2$ and $SrO-NpO_2$ the existence of the following ternary oxides could be detected: $Sr(NpO_2)$ ($a = 6.522 \pm 0.005$Å; $\alpha = 35°40' \pm 10'$); Sr_3NpO_6; and $SrNpO_3$. In the system $CaO-NpO_2-O_2$ the preparation of $Ca(NpO_2)O_2$ ($a = 6.245 \pm 0.006$Å; $\alpha = 35°41' \pm 10'$) and Ca_3NpO_6 was accomplished. Ba_3NpO_6 with Sr_3NpO_6 formed a flawless mixed crystal series $Ba_{3-x}Sr_xNpO_6$ whose individual units up to $x \leq 2.25$ possessed cubic structure. By precipitation of a concentrated neptunyl acetate solution with a solution of barium or strontium acetate the double acetates $Ba(NpO_2)_2(CH_3COO)_4 \cdot 2H_2O$ and $Sr(NpO_2)_2(CH_3COO)_4 \cdot 2H_2O$ were ob-

tained. By comparison with corresponding ternary oxides of uranium and plutonium, a true intermediate position of neptunium between uranium and plutonium was established. (tr-auth)

23360 CALCULATION OF THE EXPERIMENTAL WIDTH OF PHONON LINES WITH 3-AXIS NEUTRON SPECTROMETER. Rolf Stockmeyer (Kernforschungsanlage, Julich, Ger.). Nukleonik, 5: 121-4(Apr. 1963). (In German)

The transmission function of a 3-axis spectrometer was specified under the usual assumptions for the transmission of the collimator and the reflectivity of the crystal in integral form. From that the line form for phonons, which was excited by forward scattering of neutrons, was calculated. The square of the experimental width can be given approximately as the sum of the squares of the apparatus width and the damping constant of the phonons. (tr-auth)

23361 INDEPENDENT SLIP SYSTEMS IN CRYSTALS. G. W. Groves and A. Kelly (Cambridge Univ., Eng.). Phil. Mag., (8), 8: 877-87(May 1963).

The slip systems observed in a number of crystal structures common among metals and simple ceramic materials are examined to see whether they allow the crystal to undergo an arbitrary strain without change of volume. For most materials, other than f.c.c. and b.c.c. metals, there are insufficient independent slip systems. The condition under which cross slip can give rise to extra independent systems is stated. The results explain in a natural way recent experimental findings on the ductility of polycrystals with the sodium chloride structure. (auth)

23362 THE de HAAS-van ALPHEN EFFECT IN CAESIUM. K. Okumura and I. M. Templeton (National Research Council, Ottawa). Phil. Mag. (8), 8: 889-90 (May 1963).

The satisfactory observation of deHaas-van Alphen oscillations in cesium was reported. The absolute value of the period corresponding to a central cross section of the free electron sphere was calculated for the lattice constant of cesium at 5°K. (C.E.S.)

23363 THEORY OF IMPURITY ABSORPTION NEAR THE EXCITON BANDS IN ISOTOPIC SUBSTITUTION. E. I. Rashba (Inst. of Semiconductors, Kiev). Soviet Phys.-Solid State (English Transl.), 4: 2417-29(May 1963).

A logical theory is developed for the anomalous impurity absorption effect near exciton bands in molecular crystals, which was previously predicted theoretically and was observed experimentally. Special attention is given to the role played by long-range interactions. General formulas are obtained for the impurity absorption, which are then applied to the Heitler-London model. It is shown that in isotopic substitution the position of the impurity absorption bands is completely determined by the density of states in the exciton bands with long-range interactions. The intensity and polarization ratio for impurity bands are expressed in terms of the density of states in the bands and the dispersion of the dielectric constant of an ideal crystal. For exciton bands with different structures, a detailed investigation is made of the limiting laws governing the change in position, intensity, and the polarization ratio of the impurity absorption bands as a function of the distance between terms of the molecules of the solvent and the impurity as the impurity level approaches the edge of the exciton band. A discussion is given of the possibilities for analyzing the structure of exciton bands by making a study of impurity absorption, in the course of which values are found for the parameters of the theory. In conclusion, the results obtained are generalized in the direction of a departure from the Heitler-London approximation, including a mixture of different states, as well as the polarizability associated with other intramolecular transitions. (auth)

23364 EPR IN UNDERCOOLED SOLUTIONS CONTAINING Mn^{2+} AND Gd^{3+} IONS. N. S. Garif'yanov, R. Kh. Timerov, and N. F. Usacheva (Inst. of Physics and Tech., Kazan). Soviet Phys.-Solid State (English Transl.), 4: 2448-9(May 1963).

The electron paramagnetic resonance (EPR) spectra of Mn^{2+} and Gd^{3+} ions in borate glass were investigated to obtain information on the crystalline electric field in glasses. In the case of Mn^{2+} ions analysis of forbidden transitions in the spectrum of hyperfine structure of the EPR lines was used for this purpose. The fine structure of the EPR structure of Gd^{3+} ions was observed directly. Measurements were made at frequencies of 260 and 932 Mcs at 77°K. (C.E.S.)

23365 INVESTIGATION OF THERMAL CAPACITY OF HEAVY WATER IN SUPERCRITICAL PARAMETER REGION. L. S. Rivkin and B. N. Egorov (All-Union Heat Engineering Inst., USSR). Teploenerg., No. 12, 60-3 (Dec. 1963). (In Russian)

Experimental data are given on the thermal capacity of heavy water at 225 to 300 kg/cm^2 pressures and temperatures from 330 to 450°C. (R.V.J.)

23366 THERMAL CONDUCTIVITY OF HEAVY WATER STEAM. N. B. Bargaftik and O. N. Oleshchuk. Teploenerg., No. 12, 64-6(Dec. 1962). (In Russian)

Data are given on the thermal conductivity of heavy water steam at 150 to 500°C and 1 to 250 kg/cm^2 pressure. The thermal conductivity ratios of D_2O to H_2O in liquid and gaseous forms are correlated. (R.V.J.)

23367 FREE ENERGY OF FORMATION OF MOLYBDENUM DIOXIDE. Robert A. Rapp (Wright Patterson AFB, Ohio). Trans. AIME, 227: 371-4(Apr. 1963).

The standard molar free energy of formation of MoO_2 was determined between 750 and 1050°C in galvanic cell measurements involving the solid electrolyte $Zr_{0.85}Ca_{0.15}O_{1.85}$. Use of the reference electrodes Fe + Fe_xO and Ni + NiO provided two independent determinations of $\Delta F^0_{MoO_2}$. The data may be represented by the equation $\Delta F^0_{MoO_2} = -137{,}500 + 40.0T(°K)$, which is in good agreement with previous CO/CO_2 gas equilibrium measurements. (auth)

23368 THE OXIDATION KINETICS OF ZIRCONIUM CARBIDE. R. W. Bartlett, M. E. Wadsworth, and I. B. Cutler (Univ. of Utah, Salt Lake City). Trans. AIME, 227: 467-72(Apr. 1963).

The oxidation kinetics of ZrC were studied at 450 to 580°C in oxygen pressures from 6.5×10^{-5} to 1 atm using a thermogravimetric apparatus and sized powder samples. Two parallel rate controlling processes were observed. A surface reaction occurring at the ZrC–ZrO_2 phase boundary accounted for most of the oxidation and had an activation enthalpy of 46 kcal/mole. The other process, believed to be diffusion of O into the ZrC lattice partially replacing C, had an activation enthalpy of 53 kcal/mole. The enthalpy for chemisorption of O on ZrC was determined to be −13 kcal/mole. Water vapor in the presence of O accelerated the surface reaction rate. (auth)

23369 HIGH-TEMPERATURE OXIDATION OF ZIRCONIUM RIBBONS. C. M. Quinn and M. W. Roberts (Queen's Univ., Belfast). Trans. Faraday Soc., 59: 985-93(Apr. 1963).

The interaction of carbon dioxide and carbon monoxide with zirconium ribbons was investigated in the temperature

range 630 to 830°C and at pressures of about 10^{-1} mm. Carbon dioxide reacts dissociatively at 630° with oxidation of the metal and carbon monoxide description. At 630° dissociation ceases at an estimated oxide thickness of 650 Å. The initial rate of carbon dioxide dissociation is a function of the chemical nature of the surface and the slow step is considered to be dissociation of the molecule. Although some of the carbon monoxide reacts at 630° the rate is negligible compared with surface oxidation at the same temperature. The activation energy of the carbon monoxide reaction is ~70 kcal $mole^{-1}$ and its rate is pressure independent. Oxygen interaction in the temperature range 200 to 350°C is initially rapid but the subsequent slow process has an activation energy of ~17 kcal $mole^{-1}$ and is pressure independent. Between 630° and 830°C the activation energy is ~70 kcal $mole^{-1}$ and the rate proportional to $(pressure)^{-0.3}$ which is compatible with an anion vacancy mechanism. There is a distinct break in the oxide thickness-temperature curve at 730°C; the extent of oxidation at 730° is appreciably less if an oxide film is first formed at a lower temperature. A value of about 95 kcal $mole^{-1}$ is estimated for the heat of formation of a Frenkel defect (anion type) in zirconium dioxide. (auth)

23370 OXIDATION OF ZIRCONIUM IN AIR. Tatsuo Maekawa and Bunpei Ishii (Mitsubishi Atomic Power Industries, Inc., Saitama, Japan). Trans. Japan Inst. Metals, 3: 203-9(Oct. 1962). (In English)

The oxidation reaction of zirconium in air was studied in the temperature range 650 to 850°C. The reaction was followed up by measurements of weight change, chemical analyses of nitrogen absorbed in the oxidized specimens, and electron microscopic observations of the surface and cross section of specimens. Above 750°C, a significant breakaway phenomenon in the oxidation rate was observed, and the rate changed from an initial cubic or parabolic law to a linear one. Analyses of nitrogen indicated that the absorbed nitrogen, concentrated in the metal phase near the metal/oxide interface, could not be stable in the post-break away stage. The results of electron microscopic observations indicated that the cracking in the inner oxide layer did have a correlation with the change in kinetics, but the cracking at the surface had no correlation to it. Electron micrographs of cross sections also showed that the metal phase near the oxide layer had a greatly different appearance in structure in the post-breakaway stage from that in the initial stage. The mechanism of heavy break-away phenomenon in oxidation zirconium in air was discussed on the basis of the observations in electron micrographs with emphasis on the function of nitrogen. (auth)

23371 ON THE CRYSTAL CHEMISTRY OF THE STRONTIUM CHLORIDES. [PART] II. G. Brauer and M. Knausenberger (Universität, Freiburg i. B.). Z. Anorg. Allgem. Chem., 320: 54-8(Jan. 1963). (In German)

The solubility of $PbCl_2$, $EuCl_3$ and $EuCl_2$ in solid $SrCl_2$ was investigated by means of x-ray-diffraction and microscopic methods. $SrCl_2$ formed with $EuCl_3$ heterotypic mixed crystals. No solubility of $PbCl_2$ and $EuCl_2$ in solid $SrCl_2$ could be found. $EuCl_2$ was easily reduced by a stream of hydrogen at 400°C. Under the same conditions, the mixed crystals $SrCl_2-EuCl_3$ were reduced. (auth)

23372 CHEMICAL AND ELECTRON-OPTICAL INVESTIGATIONS OF THE REACTION OF URANYL ACETATE WITH COLLAGEN. Elisabeth Gebhardt and Klaus Kuehn (Universität, Heidelberg). Z. Anorg. Allgem. Chem., 320: 71-7(Jan. 1963). (In German)

After treatment with uranyl acetate, fibrils of collagen exhibited a cross-banded structure under the electron microscope. This striation was due to a cross linking of collagen molecules via the side chains of the amino acids. (auth)

23373 HETEROGENEOUS EXCHANGE OF ISOTOPIC AND NON-ISOTOPIC IONS ON ALKALINE EARTH SULFATES. I. INVESTIGATION METHODS AND ISOTOPE EXCHANGE WITH STRONTIUM-90. K. H. Lieser and W. Hild (Technische Hochschule, Darmstadt, Ger.). Z. Anorg. Allgem. Chem., 320: 117-34(Jan. 1963). (In German)

The heterogeneous exchange of isotopic and nonisotopic ions on the surface of ionic crystals (equivalent, cationic, and anionic particles) is discussed. The method is described and formulas of general applicability are derived. For the investigation of isotopic ion exchange in the system $SrSO_4/^{90}Sr^{2+}$, equivalent, cationic (Sr^{2+}), and anionic (SO_4^{2-}) particles are used. Two different processes are observed: rapid isotopic ion exchange (involving ions located on the surface of the crystals at the beginning of the experiment) and slow recrystallization of the solid particles. The rate of the heterogeneous ion exchange is controlled by the surface reaction, not by diffusion in the solution. The surface area of the solid particles is calculated; the values obtained are discussed. (auth)

23374 ON THE CHEMISTRY OF PLATINUM METALS. V. EQUILIBRIUM WITH $Ru_{(s)}$, $RuO_{2(s)}$, $RuO_{3(g)}$, AND $RuO_{4(g)}$. Harald Schaefer, Alfred Tebben, and Wilfried Gerhardt (Universität, Munster). Z. Anorg. Allgem. Chem., 321: 41-55(Mar. 1963). (In German)

From experiments with flowing filaments, in which clean Ru wires as well as those covered with RuO_2 were heated in O_2-N_2 atmosphere, it was found that the volatilization of Ru at temperatures ≥ 1200°C takes place predominantly as RuO_3. Transpiration measurements confirmed this result. They proved furthermore that at lower temperatures (800°C) the predominant species in the gas phase is RuO_4. The quantitative evaluation by means of Cp- and S-values, calculated on the basis of statistical methods for $RuO_3(g)$ and $RuO_4(g)$ yielded the heats of formation $\Delta H(RuO_3(g)\ 298) = -12.7$ kcal/mol and $\Delta H(RuO_4(g)\ 298) = -43.2$ kcal/mol. Observations by Alcock and Hooper are in agreement with the obtained pattern, if it is considered that in their experiments the solid phase consisted of RuO_2 instead of Ru. (auth)

23375 ABSORPTION SPECTRA OF Er^{3+} IN YTTRIUM GALLIUM GARNET. R. Pappalardo (Cyanamid European Research Inst., Cologny (Geneva), Switzerland). Z. Physik, 173: 374-91(1963). (In English)

The optical absorption spectrum at various temperatures of Er-doped yttrium gallium garnet is reported. The crystal fine structure is discussed and this suggests the presence of a highly symmetrical crystal potential. The observed fine structure was compared with the predicted splitting of the J-manifolds of Er^{3+} in an environment possessing cubic symmetry. Plots of the energies of the J-manifolds of Er^{3+} as a function of two cubic-field parameters are given. Operator-equivalent factors for Er^{3+} are tabulated and compared with the values given by Erath. The observed fine structure of the absorption is explained reasonably well by the assumption of a predominant cubic symmetry. (auth)

23376 SECTIONS IN THE QUATERNARY RECIPROCAL SYSTEM Na^+, Ca^{2+}, Ba^{2+}, :: F^-, Cl^-. Z. A. Mateiko and G. A. Bukhalova. Zh. Neorgan. Khim., 8: 715-19(Mar. 1963). (In Russian)

Phase diagram studies were carried out with salt mixtures of Na, Ca, and Ba fluorides and chlorides which are

used for the preparation of welding fluxes. In the stable reciprocal quaternary system, two sections were investigated: $Ba_2Cl_4-Ca_2F_4-Na_4Cl_4$ (I) and $Na_4F_4-Ba_2Cl_4-CaF_2\cdot CaCl_2$ (II); the first section represents an unstable ternary eutectic system while the second includes exchange compounds. The determinations were carried out by a visual thermal method in a Pt crucible, using Pt–Pt/Rh thermocouples for the temperature measurements. In system (I) seven internal sections were determined. The three fields intersect in a ternary eutectic point with a composition of 7% Ca_2F_4, 57% Ba_2F_4, and 36% Na_4F_4 and a melting point of 630°C. In system (II), the component $CaF_2\cdot CaCl_2$ melts incongruently at 736°C. Its phase diagram was determined on the basis of six internal sections and was found to be a stable tetrahedral system of five ions. Three fields of solidification have been determined: Na_4Cl_4, Ba_2Cl_4, and Ca_2F_4, the latter being the product of the incongruent decomposition of the compound $CaF_2\cdot CaCl_2$. The intersection of the three monovariant curves with the plane of the section corresponds to a temperature of 646°C with a composition of 14% $CaF_2\cdot CaCl_2$, 40% Na_4Cl_4, and 46% Ba_2Cl_4. (TTT)

Organic Chemistry

23377 MASS SPECTROMETRY IN STRUCTURAL AND STEREOCHEMICAL PROBLEMS. XXI. FRAGMENTATION AND HYDROGEN TRANSFER REACTIONS AFTER ELECTRON IMPACT ON β-DECALONES. E. Lund, H. Budzikiewicz, J. M. Wilson, and Carl Djerassi (Stanford Univ., Calif.). J. Am. Chem. Soc., 85: 1528-34(May 20, 1963).

The mass spectra of a variety of trans- and cis-β-decalones together with their deuterated analogs were measured in order to determine the principal fragmentation modes as well as to examine the occurrence of hydrogen transfer reactions. A comparison of the present results with those of the earlier recorded α-decalone mass spectra show very distinct differences, which are of diagnostic value and which are discussed in detail. In contrast to α-decalones, where the stereochemistry of the ring juncture played an important role, both trans- and cis-β-decalones exhibit very similar mass spectral fragmentation patterns. (auth)

23378 AN IMPROVED SYNTHESIS OF DL-[1-^{14}C] GLYCERIC ACID. J. M. Ashworth (Univ of Leicester, Eng.). J. Chem. Soc., 2563-4(Apr. 1963).

An alternative synthesis route to DL-[1-C^{14}] glyceric acid is described which gives an overall yield of 70%. The route involves the formation of a nitrile from glycollaldehyde, sodium [C^{14}] cyanide, and benzoyl chloride; the isolation of the nitrile; and finally the acid hydrolysis of the nitrile. (D.L.C.)

23379 SOME CHARACTERISTIC FREQUENCIES OF AMINO ACIDS. Masamichi Tsuboi (Yokyo Univ.), Tadao Takenishi, and Asao Nakamura. Spectrochim. Acta, 19: 271-84(Jan. 1963).

On the basis of the observations of the infrared absorption spectra of several α-amino acids, some of the related compounds, some of their N— and C— deuterated derivatives, their N^{15}-substitution products, and their sodium salts, and their hydrochlorides, the characteristic frequencies are indicated of their following vibrations: NH_3^+ degenerate deformation, NH_3^+ symmetric deformation, ND_3^+ deformations, NH_3^+ rocking, ND_3^+ rocking, C—N stretching, COO^- antisymmetric stretching, COO^- symmetric stretching, some COOH vibrations, and some COOD vibrations. Brief discussions are given of the natures of actually observed bands corresponding to these vibrations. (auth)

Radiation Chemistry and Radiochemistry

23380 (IFA/CO/21) BIBLIOGRAPHY OF CARBON-14 MEASUREMENTS. Ana Genunche (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1962. 60p.

References (408) are given to U. S. and foreign journals and books published from 1940 to 1962. Separate author and subject indexes are included. (P.C.H.)

23381 (PA-TR-3072) COBALT-60 GAMMA RADIOLYSIS OF LIQUID DINITROGEN TETROXIDE. Thomas C. Castorina (Picatinny Arsenal. Feltman Research Labs.). May 1963. 62p.

Gamma radiolysis of liquid dinitrogen tetroxide (N_2O_4) was investigated as a function of variations in temperature, gas-to-liquid volume ratio, dose rates, and method of N_2O_4 purification. The radiolytic products are shown to be N_2, N_2O, and N_2O_5. The material balance of the O_2 released at post-irradiation thermal equilibrium as compared with the calculated O_2 derived from the production of N_2 and N_2O from N_2O_4 is good to within 10%. Liquid N_2O_4 is relatively radiation-resistant, having a G value of only 0.075, the ratio of N_2 and N_2O product formation being 2 : 1. The independence of product yields in relation to changes in dose rate indicates that radical-molecule processes are involved in product formation. An apparent induction period, observed at 0.4 Mrad per hour, is also shown to be independent of dose rate. The addition of Ar to liquid N_2O_4 has no effect on the radiolytic yields. The addition of O_2, over the partial pressure range of 200 to 350 mm, results in a G value for N_2O_5 formation that is in excellent agreement with that for N_2O_5 formation from pure liquid N_2O_4. Although the addition of O_2 has no effect on the N_2O formation, the induction period for N_2 is eliminated and the amount of N_2 is decreased by 80%. (auth)

23382 (RRL-109) QUARTERLY REPORT [ON RADIATION CHEMISTRY], JANUARY 1, 1963–MARCH 31, 1963. Fundamental Research No. 6041. (Mellon Inst. Radiation Research Labs., Pittsburgh). Apr. 15, 1963. Contract AT(30-1)-2310. 15p. (NYO-10479)

Brief summaries are given of work on radical yields in liquid 1-butene, photolysis and radiolysis of trimethylamine, radiolysis of methane, free radical methylation of benzene, radiolysis of 1,4-cyclohexadiene, and radiation chemistry of aqueous solutions of acetaldehyde. (P.C.H.)

23383 (RRL-112) ELECTRON SPIN RESONANCE STUDIES OF TRANSIENT ALKYL RADICALS. R. W. Fessenden and R. H. Schuler (Mellon Inst. Radiation Research Labs., Pittsburgh). Apr. 26, 1963. Contract AT (30-1)-2310. 175p.

Electron spin resonance methods were used to observe alkyl radicals in liquid hydrocarbon systems during irradiation with 2.8-Mev electrons. The results provide detailed structural, radiation chemical, and kinetic information on a large number of radicals. In general the ESR lines were found to be narrow, and considerable fine structure, which permitted positive assignment of the radical species, was observed. Accurate hyperfine constants are reported for 21 alkyl and cycloalkyl radicals (including several deuterated species, vinyl, 1-methylvinyl, 3-butenyl, allyl, and cyclohexadienyl radicals and hydrogen

and deuterium atoms. The radicals observed in various hydrocarbons are discussed in terms of the radiation chemical reactions expected in the systems. In most cases the radicals represent fragments that result from rupture of a single bond. In certain cases secondary reactions, such as the addition of hydrogen atoms to unsaturates, were also found to be important. The use of ESR methods in obtaining information concerning the rate of radical reactions is illustrated. (P.C.H.)

23384 (SCR-593) THE ADSORPTIVE AND RADIOCOLLOIDAL PROPERTIES OF CARRIER-FREE SILVER. Hans L. Hamester and Milton Kahn (New Mexico. Univ., Albuquerque). Jan. 1963. Contract AT(29-1)-789. 46p.

The removal of carrier-free Ag^{110m} from dilute nitric acid and aqueous solutions of miscellaneous common reagents by adsorption on Pyrex is studied. Adsorption is believed to occur by a relatively rapid cation-exchange process followe : by a slow diffusion step. Radiocolloids are detected by high-speed centrifugation in 0.0001 to 0.01M nitric acid. These radiocolloids are produced as a result of adsorption of silver by siliceous and organic dust particles. (N.W.R.)

23385 (TID-16894) α/β RATIOS AND RELATIVE RADIATION SENSITIVITY OF ORGANIC SCINTILLATION SOLUTIONS. I. B. Berlman, R. Grismore, and B. G. Oltman (Argonne National Lab., Ill.). July 1962. Contract [W-31-109-eng-38]. 19p. (UAC-6665)

The effect of dynamic quenching in organic scintillation liquids on the value of the α/β ratio is shown to be influenced by the decay time of the solvent and/or the solute. In ternary systems containing cyclohexane and benzene in various proportions as the solvents and diphenyloxazole (PPO) as the solute the effect of the decay time of the solvent on the α/β ratio is demonstrated by a luminescence minimum. Also, the α/β ratio is shown to vary as the decay time of the solute in four binary solutions with benzene as the common solvent. The assumption is made that the magnitude of the dynamic quenching in a binary solution should be influenced by the radiation susceptibility of the solvent to the formation of transient free radicals (G_r). In eleven solutions with PPO as the common solute the α/β ratio appears to vary inversely as G_r of the solvent. (auth)

23386 (UCRL-10360(Rev.)) CHEMICAL EFFECTS FOLLOWING THE $S^{34}(n,\gamma)S^{35}$ REACTION IN GASEOUS-SULFUR COMPOUNDS. M. Lee Hyder and Samuel S. Markowitz (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1962. Contract W-7405-eng-48. 30p.

The chemical behavior of S^{35} formed by the $S^{34}(n,\gamma)$ reaction was studied in gaseous H_2S, SO_2, SF_6, CH_3SH, and thiophene. The reaction was obtained by sealing the gases in quartz ampules and irradiating them with thermal neutrons. Among the effects studied were those of pressure, surface area, and additive gases including Ar, NO, O, and H. The S^{35} was recovered in gaseous compounds and in deposits on the walls of the ampules; the chemical composition of both portions of activity was determined by aqueous chemistry using carriers. The results are consistent with a model in which the original molecule is broken up in the recoil process and the resulting fragments containing S^{35} react with the surroundings only after they have slowed to thermal energies; in general, the final chemical form of the S^{35} is determined by the chemical environment in which it is produced rather than by its original oxidation state or chemical form. However, irradiations of mixtures of several gases with NO gave results possibly indicating that the chemical form of the S^{35} immediately after molecular disruption may depend upon the nature of the original molecule. (auth)

23387 (UCRL-10687) FORMATION OF ENERGETIC FRAGMENT IONS BY BOMBARDMENT OF ORGANIC MOLECULES WITH SLOW ELECTRONS (thesis). John A. Olmsted (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 18, 1963. Contract W-7405-eng-48. 132p.

Excess-kinetic-energy fragment ions resulting from the bombardment of organic molecules with 0- to 100-volt electrons were studied by using the techniques of mass spectrometry. The effects of such ions of variations in the mass-spectrometer operating conditions were determined. The excess kinetic energies possessed by both near-thermal and excess-kinetic-energy methyl ions were measured for a large number of organic compounds, and it is found that most "thermal" methyl ions have about 0.3 ev excess kinetic energy. Energies measured for excess-kinetic-energy methyl ions are in agreement with those determined by other experimenters, if the latter values are corrected by the addition of the excess kinetic energies of the near-thermal methyl ions. Relative abundances of thermal and excess-kinetic-energy methyl ions were determined for several organic compounds, and it is found that under normal operating conditions, the $M/q = 15$ ion peak observed in the mass spectrometer is made up, for most of the compounds studied, of 50 to 70% excess-kinetic-energy ions. Moreover, the absolute abundances of excess-kinetic-energy ions were estimated from the measured peak heights, and it is found that for hydrocarbon molecules like propane and n-butane the excess-kinetic-energy methyl ions make up more than 10% of all ions formed from those molecules by impact of 70-v electrons. Appearance-potential measurements were made for the excess-kinetic-energy methyl ions from several organic compounds. In all cases, the appearance-potential curves have a second-power dependence on excess electron energy in the threshold region. This behavior is explained by modifying slightly the theory for threshold behavior of appearance-potential curves. All the appearance potentials determined lie in the 25 to 30 v range. The mechanism for formation of excess-kinetic-energy ions is discussed, and it is shown that the previously postulated mechanism involving the fragmentation of doubly charged ions is not consistent with the data. An alternative mechanism involving excited states of singly charged ions is presented. Finally, the implications of the existence and abundances of excess-kinetic-energy ions for the quasi-equilibrium theory of mass spectra are examined. It is concluded that the assumption of randomization of excitation energy on which that theory is based is completely invalid. Furthermore, the complete failure of the theory to predict the existence of an abundant-methyl-ion peak in the propane mass spectrum is pointed out. 53 references. (auth)

23388 (CEA-tr-X-506) ACTIVATION DE L'INDIUM PAR UNE SOURCE NEUTRONIQUE DE RADIUM ET BÉRYLLIUM. (Activation of Indium with a Radium–Beryllium Neutron Source). Hinoshita and Suji. Translated into French from Nippon Kagaku Zasshi, 81: 1087-90 (1960). 18p. (includes original, 4p.).

The activation of indium by irradiating it in aqueous solution with a Ra–Be neutron source was examined. The relation between the dimensions of the thermal neutron beam and the distance from the source in the moderator milieu was determined. A maximum of the thermal neutron beam was established at 0.5 cm from the source if the moderator is paraffin and 1 cm if the moderator is water. Up

to 5 cm from the source the neutron beam in the paraffin was 22% stronger than in the water. Aqueous solutions containing the same quantity of In but in different volumes were irradiated by placing the neutron source in the center of the solution. An activation maximum was observed for a volume of about 100 cm^3. This activation, when the container is surrounded by paraffin, was 8% higher than when it was surrounded by water. The relation between the indium concentration and the activation intensity resulting for two solutions, one of 115 cm^2 and 105 cm^3, was established. The better proportionality was obtained with the 115 cm^3 volume, which shows that the self-screening effect of the sample with respect to neutrons decreases when the sample volume increases. By increasing the sample volume, the perturbation from the presence of foreign elements was decreased. It was shown that such a perturbance can be predicted by consideration of the neutron absorption equivalent. Some application examples are given. (tr-auth)

23389 SYNTHESIS OF POLYMETHYLENES FROM CARBON MONOXIDE AND HYDROGEN USING AN IRRADIATED RUTHENIUM CATALYST. H. Pichler and B. Firnhaber (Technische Hochschule, Karlsruhe, Ger.). Angew, Chem., 75: 166(Feb. 3, 1963).

Irradiation of a RuO_2 catalyst in air or in an evacuated glass tube with γ radiation from a Co^{60} source (4×10^5 r/hr) for 65 hr renders it unusually active towards hydrocarbons. It reacts at room temperature with nonane, which glows and ignites to give CO_2 and water. Unirradiated RuO_2 does not react with nonane. If the radioactivated RuO_2 catalyst is introduced with nonane into an autoclave, and the mixture compressed with the synthesis gas, then at 1000 atm and 132°C much more hydrocarbon is formed per unit of time from CO and H_2 than with an unirradiated catalyst. The chemical and physical properties of the synthetic product are described. (TCO)

23390 THE RADIOCHEMICAL LABORATORIES OF CENTRE d'ETUDES NUCLEAIRES AT FONTENAY-AUX-ROSES. S. Trouvé. Bull. Inform. Sci. Tech. (Paris), No. 68, 3-15(Jan. 1963). (In French)

The building devoted to 3 sections of the plutonium-chemistry services is divided into two parts and covers a surface of 80 × 100 meters. There are 3 zones: an inactive zone (offices, library, infirmary, etc); a transition zone (corridor and cloak-rooms); and an active zone consisting, for each part, of 4 hot laboratories and 1 testing bay. The basements house the technical galleries, the effluent reservoirs, the transformation units, etc., and, in particular, the special chambers for the drying of the plutonium. The ventilation installations for the various sections of the building and those for the glove-box extraction are housed in the roofing. Special precautions were taken for the safety of the building and its surroundings; the amounts of plutonium in it are strictly limited, and severe measures have been taken to deal a failure in the electricity supply or in the ventilation, as well as to avoid fire and contamination risks. (auth)

23391 GASCOGNE. Y. Artur. Bull. Inform. Sci. Tech. (Paris), No. 68, 23-7(Jan. 1963). (In French)

Gascogne is a set of two α-γ enclosures designed to study some processes for UP 2 (Plutonium Works No. 2). An installation set consists of 6 stainless steel airtight cells, shielded by a 10 mm thick casing of lead. A shielded fume-hood is provided for analytical control in a plastic box, protected by a removable 50 mm thick casing of lead. (auth)

23392 CARMEN. AN α β γ RADIO-CHEMICAL FUME-HOOD CHAIN. C. Lheureux and G. Lefort. Bull. Inform. Sci. Tech. (Paris), No. 68, 29-36(Jan. 1963). (In French)

The Carmen α-β-γ installation was designed for experimenting with chemical treatments of irradiated fuels on a laboratory scale. It is intended in particular for research on fuels for the pile Rapsodie, but can be used for any other study on the conventional process involving a solvent treatment. It is designed for the handling of about 10 curies γ per cell and is located in the radiochemical building at Fontenay-aux-Roses. A description of this chain is given including the framework, the bodywork, the protection, and the interior equipment already in service. (auth)

23393 PREPARATION OF PROTACTINIUM-231 FROM SILICEOUS RESIDUES OF JOACHIMSTHAL. Jacques Vernois, Pierre Conte, and Roland Muxart (Faculté des Sciences, Paris). Bull. Soc. Chim. France, No. 2, 403-5 (Feb. 1963). (In French)

A 4-g concentrate containing 21 mg of Pa_2O_5 was separated from 78 kg of siliceous residues from Joachimsthal. (tr-auth)

23394 THE LUMINESCENCE OF UNACTIVATED ALKALI IODIDES. Z. L. Morgenštern and N. N. Vasiljeva (Lebedev Inst. of Physics, Moscow). Czech. J. Phys., 13: 226-30(1963). (In English)

Two shorter wave-length emission bands were observed in activated alkali iodides at γ and light excitation apart from activator emission. The shortest wave-length band, observed only at low temperatures, is excited in exciton absorption bands and it may be due to exciton emission. This emission has greater intensity in unactivated crystals grown from the solution. This emission on CsI, KI and RbI crystals was observed. The intermediate emission band is excited in a narrow excitation band, situated on the sharp slope of the fundamental absorption in crystals and it can apparently be ascribed to structural defects. (auth)

23395 THE FORMATION OF ION RADICALS BY GAMMA IRRADIATION OF THE TETRA-HYDROFURAN-STYRENE SYSTEM AT −196°C. A. I. Nepomnyashchii, V. I. Muromtsev, and Kh. S. Bagdasar'yan (Karpov Inst. of Physical Chemistry, USSR). Dokl. Akad. Nauk SSSR, 149: 901-4(Apr. 1, 1963). (In Russian)

Samples of tetrahydrofuran (THF), styrene, and mixtures of these two compounds were freed from air in high vacuum and were irradiated at −196°C by Co^{60} at a dose from 0.14 to 6×10^6 rads. Polycrystalline THF irradiated at −196°C showed an electron paramagnetic resonance (EPR) spectrum having a 5-component, superfine structure due to the action of an unpaired electron with four protons. The ratio of intensities of the components approached a binomial distribution at −160°C, and the resulting EPR spectrum could be assigned to a cation radical of THF with the positive charge on the oxygen atom. On irradiating a solution of styrene in THF (2.18 mol/l) at −196°C with a dose of 0.14×10^6 rads, it was found that the form of the EPR signal depends on the power level of the signal generator. A saturated signal was observed at 5 Mw, and an unresolved singlet was obtained at a low power of 5 μ Mw. The signal form of γ-irradiated, pure THF did not depend on the irradiation dose (from 0.14 to 6.0×10^6 rads) in the absence of saturation, but the intensity was proportional to the dose. A study of the irradiation of mixtures of styrene and THF showed that a saturated signal is obtained at a lower power level for a lower irradiation dose. The power

of the signal generator was a factor of 20 less at a dose of 0.14×10^8 rads as compared to a dose of 0.84×10^8 rads. Illumination of an irradiated styrene solution in THF with light from a mercury vapor lamp resulted in the disappearance of one of the characteristic singlet lines, and was proof of the formation of two radicals during the γ-irradiation of this system. The variation in signal form as a function of power level of the signal generation can be explained by the different times of relaxation and cross-relaxation of these two radicals. Apparently, an anion radical of styrene is formed by capture of a thermal electron during the γ-irradiation. (TTT)

23396 THE EFFECT OF OXYGEN ON THE COUPLING OF DYES BY PROTEINS DURING IRRADIATION. T. E. Pavlovskaya and A. G. Pasynskii (Bakh Inst. of Biochemistry, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 149: 976-8(Apr. 1, 1963). (In Russian)

The amount of oxygen bound to protein by the action of ionizing radiation is determined indirectly by the decrease in dye absorption by protein irradiated in air. A volume of 0.5 ml of a 0.02% dye solution of malachite green was added to each of two irradiated and unirradiated samples (2 ml) of a 0.3% albumin solution, and the extinction ratio was determined to obtain the relative coupling of the dyestuff to the protein. One molecule of dye was absorbed per molecule of protein (r = 1) for the unirradiated protein. The value of r rose to 3 on irradiating the protein in vacuum. The limiting value of r was 2 on irradiating in air. Oxygen competed with the dyestuff for absorption by the protein. The displacement of the dyestuff was proportional to the partial pressure of oxygen with the value of r decreasing linearly from 200 to 760 mm Hg std air pressure during the irradiation at a dose of 130,000 r. The results showed that less than one molecule of O_2 is absorbed per molecule of protein during irradiation. (TTT)

23397 THE EFFECT OF HIGH-ENERGY RADIATION ON CELLULOSE. Rikizo Imamura (Himeji Inst. of Tech., Japan). Genshiryoku Kogyo, 9: 62-8(Jan. 1963). (In Japanese)

Exposure of cellulose to high-energy radiation at a dose rate level above 10^8 r was found to result in depolymerization, reduction of the crystallinity, and extensive decomposition, both in the amorphous and the crystalline areas of the material. The theoretical treatment of A. Charlesby of the radioinduced degradation of cellulose and the experimental results obtained by J. F. Saeman on the irradiation of cotton linters are discussed, outlining the chemical changes occurring during exposure to radiation and describing the methods used for identifying the degradation products. Paper chromatography was used for analyzing the sugars formed by the hydrolysis of irradiated cotton linters. (TTT)

23398 IRRADIATION FACTOR-DEPENDENCY. EXPLORATORY STUDIES, IRRADIATION CYCLE, AND DEGASSING. E. F. Degering, Charles Merritt, Jr., M. Bazinet, and G. J. Caldarella (Army Natick Labs., Natick, Mass.). Ind. Eng. Chem., Prod. Res. Develop., 2: 114-18 (June 1963).

Atmosphere (including small amounts of moisture or oxygen), dose rate, irradiation cycle or time interval between successive exposures, and temperature are significant variables or experimental parameters for the irradiation-induced polymerization of vinyl monomers by use of an electron accelerator operating at 2 Mev. The molecular weight of the polymer may be predetermined within limits by appropriate selection of variables. Small amounts, 1%, of another monomer added to styrene may have a pronounced effect on both conversion to polymer and on the molecular weight of the product. The molecular structure of the polymer, moreover, as evaluated by infrared spectroscopy, might vary as a function of atmosphere, including small amounts of moisture and oxygen. (auth)

23399 REACTION CONSTANTS OF THE HYDRATED ELECTRON. Sheffield Gordon, Edwin J. Hart, Max S. Matheson, Joseph Rabani, and J. K. Thomas (Argonne National Lab., Ill.). J. Am. Chem. Soc., 85: 1375-7(May 20, 1963).

Intense pulses of energetic electrons produce an absorption in the visible in aqueous solutions which is attributed to the hydrated electron, e^-_{aq}. By following the decay of this absorption at 5780 Å, rate constants for a number of reactions of the hydrated electron were measured. The effect of ionic strength on the rate constant for e^-_{aq} + ferricyanide ion, as well as the fact that some of the added reactants are known electron scavengers, confirms that the absorption is due to e^-_{aq}. Among the rate constants measured are: $e^-_{aq} + H^+_{aq}$, $2.36 \pm 0.24 \times 10^{10}$ $\underline{M}^{-1}$ sec^{-1}; $e^-_{aq} + H_2O_2$, $1.23 \pm 0.14 \times 10^{10}$ $\underline{M}^{-1}$ sec^{-1}; $e^-_{aq} + O_2$, $1.88 \pm 0.2 \times 10^{10}$ $\underline{M}^{-1}$ sec^{-1}; and $e^-_{aq} + e^-_{aq}$, 1×10^{10} $\underline{M}^{-1}$ sec^{-1}; all rate constants being for $-d(e^-_{aq})/dt$. (auth)

23400 THE ACTION OF ^{60}Co-GAMMA-RAYS ON AQUEOUS SOLUTIONS OF HYDROGEN SULPHIDE AND OF CYSTEINE HYDROCHLORIDE. J. E. Packer (Inst. of Nuclear Sciences, D.S.I.R., Lower Hutt, N. Z.). J. Chem. Soc., 2320-5(Apr. 1963).

The radiolysis of dilute aqueous hydrogen sulfide and cysteine hydrochloride in the presence and in the absence of oxygen was studied. The mechanism postulated for the short-chain reaction found only in oxygenated systems involves an intermediate sulphenylperoxy-radical, R·S·O·O·, which abstracts hydrogen from a thiol in the relatively slow propagation step [R = H or $NH_2 \cdot CH(CO_2H) \cdot CH_2 \cdot S$]. It is suggested that a similar mechanism occurs in the autoxidation of hydrogen sulfide and thiol solutions. (auth)

23401 A CHANGE IN RADIOACTIVE PRODUCT DISTRIBUTION FOR RECOIL TRITIUM REACTIONS IN THE SOLID PHASE AT −196°C. E. K. C. Lee and F. S. Rowland (Univ. of Kansas, Lawrence). J. Inorg. Nucl. Chem., 25: 133-5(Mar. 1963).

A series of experiments was performed in which recoil tritium atoms from the $Li^6(n,\alpha)T$ reaction were reacted with trans-butene-2 at 20, −78, and −196°C. The tritium distribution in the products was similar at 20 and −78°C, but the distribution at −196°C showed a decrease in CH_3CH = CHT and an increase in $\underline{n}$-C_4H_9T. Several possible causes for the changes are discussed. (D.L.C.)

23402 ANNEALING OF CHEMICAL RADIATION DAMAGE IN CRYSTALLINE BARIUM NITRATE. S. R. Mohanty and S. R. Upadhyay (Banaras Hindu Univ., India). J. Inorg. Nucl. Chem., 25: 309-10(Apr. 1963).

Results are reported on the isothermal annealing kinetics of gamma-irradiated $Ba(NO_3)_2$. Radiation doses were ~50 Mrad, and the damage nitrite was estimated spectrophotometrically. The annealing pattern is of an initial rapid reaction followed by a monotonically slow one. The fraction annealed is rather small, being ~0.17 after 50 hr at 275°C. It is concluded that the diminution of the damage nitrite in $Ba(NO_3)_2$ is a true annealing phenomenon. (D.L.C.)

23403 A NEW APPARATUS FOR GENERATION OF IODINE 132. E. Hatzopoulos (CEN, Saclay, France). J. Inorg. Nucl. Chem., 25: 462-3(Apr. 1963). (In French)

A procedure is given for separating I^{132} from fission-

product Te (containing Te^{132}, the parent of I^{132}) using an Al extraction column containing about 5 g of Al. (T.F.H.)

23404 INVESTIGATION OF PROCESSES OF ENERGY TRANSMISSION BY LUMINESCENCE AND RADIATION CHEMISTRY. V. A. Kongrauz and I. N. Vasil'ev (Karpov Physico-Chemical Inst., USSR). Kinetika i Kataliz, 4: 67-75(Jan.-Feb. 1963). (In Russian)

Radiolyses and luminescence studies of a toluene-benzoyl-peroxide-luminophore (m-terphenyl or 2,5-diphenyloxazole) solutions showed that protective effects of luminophores on a sensitized radiative decay of an oxide and quenching of photo- and radio-luminescence of luminophores are explained on the basis of competing energy transfers. (R.V.J.)

23405 ON DETERMINATION OF RADICAL YIELD IN RADIOLYSIS OF DIISOPROPYL ETHER IN REACTION WITH $FeCl_3$ ACCEPTOR. V. V. Saraeva and E. Z. Novgorodova (Moscow State Univ.). Kinetika i Kataliz, 4: 163-6(Jan.-Feb. 1963). (In Russian)

The yield of free radicals in diisopropyl ether was determined using freshly prepared $FeCl_3$ in 2.5×10^{-4} to 1.5×10^{-3} mole/l concentration irradiated at 25 ± 1°C by 2.2×10^{14} to 8×10^{15} ev/ml. sec doses. It is shown that at high radiation doses the reduction yield of Fe(III) does not reach a maximum. The yield of Fe(III) at low doses reaches a maximum G(–Fe III) = 13.5 equiv/100 ev. (R.V.J.)

23406 RADIATION-INDUCED CATIONIC POLYMERIZATION OF ETHYLENE. Yoneho Tabata, Akira Hara, and Hiroshi Sobue (Tokyo Univ.). Kogyo Kagaku Zasshi, 65: 964-6(June 1962). (In Japanese)

Liquid ethylene samples were irradiated by a Co^{60} γ source within the rate range of 4.9×10^4 to 1.04×10^5 r/hr. No induction period was observed. The rate of polymerization was found to be proportional to the first power of the dose rate, not inhibited by radical scavengers, and greatly accelerated by the presence of ethylene chloride. Hence, the polymerization of the samples at low temperature must have proceeded through a cationic mechanism. This was confirmed by the presence of radioinduced low hydrocarbons, such as C_3 and C_4 under the same condition through mass spectra. (OID)

23407 ELECTRON SPIN RESONANCE SPECTRA OF UNSATURATED RADICALS IN IRRADIATED TETRA-ALKYL AMMONIUM HALIDES. A. J. Tench (Brookhaven National Lab., Upton, N. Y.). Nature, 198: 578-9(May 11, 1963). (BNL-6544-R)

Well-resolved electron spin resonance spectra of allyl-type radicals were observed in irradiated polycrystalline tetra-alkyl ammonium halides at room temperature. The spectra were recorded on a Varian electron spin resonance spectrometer. Possible mechanisms involved in the production of these olefinic radicals are discussed. (C.H.)

23408 THE APPLICATION OF BETA-GAMMA COINCIDENCE METHODS TO RADIOISOTOPES WITH COMPLEX DECAY SCHEMES. D. E. Vaughan (Royal Military Coll. of Science, Shrivenham, Swindon, Wiltshire, Eng.). Nucl. Instr. Methods, 22: 186-8(Mar. 1963). (In English)

The applicability of beta-gamma coincidence counting to the determination of single radioisotopes with multiple decay schemes is demonstrated. An extension of this method to mixtures of radioisotopes is proposed and the necessary conditions are discussed. (auth)

23409 ULTRASONIC CAVITATION INDUCED BY NEUTRONS. B. Hahn and R. N. Peacock (Univ. of Freiburg i. B.). Nuovo Cimento (10), 28: 334-40(Apr. 16, 1963). (In English)

Neutrons from a Pu-Be source nucleate cavitation in liquid CCl_2F_2 (Freon 11) when it is excited with ultrasonic pressure waves corresponding to ±5 atm at 25 kHz. The bubbles grow to visible size within one ultrasonic period and disappear in a few tens of cycles. Standing-wave bubble patterns were observed. The creation of a cavity is accompanied by a large and very fast light pulse with a decay time faster than 6 nsec. Methyl acetate containing dissolved uranium nitrate can be made continuously sensitive to fission fragments at a lower sound level. (auth)

23410 ENHANCED IONIC POLYMERIZATION OF STYRENE INDUCED BY RADIATION. A. Charlesby and J. Morris (Royal Military Coll. of Science, Shrivenham, Eng.). Proc. Roy. Soc. (London), Ser. A, 273: 387-99 (May 21, 1963).

The radiation-induced ionic polymerization of styrene at −78°C was studied, at various concentrations in dichloromethane solutions, in the presence of silica powder, and at various radiation intensities. Both yield of polymer, and average molecular weight were determined, allowing an estimate of G_i for ionic polymerization to be made. The yield is greatly reduced by traces of water and this is ascribed to increased termination. On the assumption that chain transfer is small, Aerosil powder appears to cause an increase in initiation, rather than a reduction in termination. Evidence is presented for the view that the enhanced reaction occurs by the surface adsorption of sytrene ions, so that the radiation intensity dependence changes from $I^{1.0}$ to $I^{0.5}$. Energy absorbed in the solvent is also found to be capable of initiation. (auth)

23411 CHEMICAL EFFECTS OF IONIZING RADIATION ON AQUEOUS SOLUTIONS OF ALDOHEXOSES. Glyn O. Phillips (Univ. of Wales, Cardiff). Radiation Res., 18: 446-60(Apr. 1963).

Paper chromatographic and radioisotopic methods were used to identify products formed during irradiation of glucose solutions in vacuo with Co^{60} γ radiation and 1-Mv electrons. By reference to yield-dose curves, several primary processes were recognized: oxidation at C-1 to give gluconic acid; attack at C-2 to give glucosone; ring scission to yiele two- and three-carbon aldehydic fragments; and dimerization of radicals of the type RĊHOH as an initial step in the formation of polymeric material. Consideration is given to the effect of oxygen on the general pattern of aldohexose degradation. The nature and yields of products indicate that primary abstraction are identical in oxygen and in vacuo. The differing products found must be attributed to differing secondary reactions of identical primary species. There is evidence that abstraction by hydroxyl radicals cannot solely account for the whole of initial hexose degradation observed, which is the same in oxygen and in vacuo (–G = 3.5). (auth)

23412 THE RADIATION DECOMPOSITION OF ADENINE. C. Ponnamperuma, R. M. Lemmon, and M. Calvin (Univ. of California, Berkeley). Radiation Res., 18: 540-51 (Apr. 1963).

The radiolysis of 0.1% solutions of adenine in water leads to the formation of two major products: 4,6-diamino-5-formamidopyrimidine and 8-hydroxyadenine. The two compounds account for about 60% of the decomposed adenine. Minor products are hypoxanthine and 4-amino-5-formamido-6-hydroxypyrimidine. It is probable that all the reactions may occur in intact nucleic acids, and that they may therefore be of importance in radiobiology. (auth)

23413 ELECTRON SPIN RESONANCE STUDIES OF RADIATION EFFECTS ON POLYAMINO ACIDS. Russell C. Drew and Walter Gordy (Duke Univ., Durham, N. C.). Radiation Res., 18: 552-79(Apr. 1963).

The effects of ionizing radiation on eighteen polyamino acids were examined with the ESR method. In about half of these it was found possible to interpret the ESR observed at room temperature as arising from free radicals formed by loss of the H from the –CHR– group of the polypeptide chain. In the others, the room-temperature ESR signals seem to arise from a damaged side chain or R group. The ESR obtained at 77°K are generally different from those obtained in room-temperature experiments and may arise often from charged or ionized molecules. Oxygen was found to alter or quench the ESR of all the polyamino acids studied, some more rapidly than others. The alteration of the signal is thought to be caused by a conversion of the radical X to peroxide radicals X–O–O. The later decay of the signal probably results from the release of H atoms, that escape through the lattice, and the consequent conversion of the polymeric free radicals to stable molecules. (auth)

23414 THE UNIVERSAL 60,000C APPARATUS WITH A Co^{60} GAMMA-RADIATION SOURCE FOR SIMULATING CHEMICAL RADIATION APPARATUS AND CARRYING OUT RESEARCH. A. Kh. Breger, V. P. Osipov, and V. A. Gol'din. Radioaktivn. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1960, 1: 227-32 (1961).

A universal apparatus is described for simulating chemical radiation apparatus and for conducting research with a Co^{60} γ radiation source of activity ~ 60,000 g-equiv of radium. The design enables a powerful source of radiation to be assembled safely using a special container for transportation and charging. The apparatus can be used for simulating chemical radiation apparatus with powerful isotopic sources of γ radiation, and of various shapes and dimensions. (Referativnyy zhurnal, Khimiya, No. 4, 1962)

23415 A NOTE ON THE ACTION OF GAMMA RAYS ON AN AQUEOUS SOLUTION OF OXALIC ACID. Lj. Josimović and I. Draganić (Inst. of Nuclear Science "Boris Kidrich," Vincha, Yugoslavia). Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 57: 29-30(Mar. 1963). (In English)

Comments are offered on Matsui's work on the radiolysis of oxalic acid solutions (ibid., 53, 290(1959)). It is contended that there are only two regions of the G-value, one where G = 4.9 and the other where G decreases with dose at decompositions above 30%, and that Matsui's finding G > 6 at low decompositions may be due to errors. The errors in the titration of irradiated solutions are discussed. The use of an oxalic acid solution as a chemical dosimeter is criticized. (D.L.C.)

23416 REPLY TO COMMENTS BY JOSIMOVIĆ AND DRAGANIĆ. Masao Matsui (Syracuse Univ., N. Y.). Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 57: 31-2(Mar. 1963). (In English)

Experimental data are given as evidence for G > 6 in the radiolysis of oxalic acid solutions. It is pointed out that data were collected with a view to devising a simple dosimeter and that, if chlorobenzene–water is used with the oxalic acid, dosimetric measurements in the range of 2×10^5 to 1.3×10^8 r are possible. (D.L.C.)

23417 ^{60}Co γ-RADIOLYSIS OF N,N-DIMETHYLFORMAMIDE. N. Colebourne, E. Collinson, and F. S. Dainton (Univ. of Leeds, Eng.). Trans. Faraday Soc., 59: 886-94(Apr. 1963).

The chemical changes resulting from the Co^{60} γ-irradiation of pure DMF and solutions of ferric chloride, acrylonitrile, or ferric chloride + acrylonitrile in DMF were investigated. The distribution of the radiolysis products, carbon monoxide, hydrogen, methane, and dimethylamine, suggest that fission of the carbonyl-nitrogen and nitrogen-methyl bonds are the most probable reactions. G(–$FeCl_3$) has a maximum value of 12.4 ± 1.0. (auth)

23418 CHEMICAL EFFECTS OF RADIATIVE THERMAL NEUTRON CAPTURE. PART 10. INFLUENCE OF CRYSTAL DEFECTS ON THE RETENTION. A. G. Maddock, F. E. Treloar, and J. I. Vargas. Trans. Faraday Soc., 59: 924-34(Apr. 1963).

It is shown that the retention and the annealing characteristics following neutron irradiation of potassium chromate are determined to some extent by the treatment of the crystals before irradiation. Crushing or irradiating the crystals with electrons before neutron irradiation reduces the retention but renders the products more susceptible to thermal annealing. A quantitative study of the combination of thermal and radiation annealing is reported. It is suggested that these and other observations reflect the influence of crystal defects on the fate of the recoiling atom and the subsequent annealing reactions. Three possible mechanisms of radiation annealing are discussed and a mechanism involving the defects is found compatible with all the existing data. By a simple development of this model all the other annealing phenomena in potassium chromate crystals can be interpreted. (auth)

23419 CHEMICAL EFFECTS OF RADIATIVE THERMAL NEUTRON CAPTURE. XI. THERMAL AND RADIATION ANNEALING IN NEUTRON IRRADIATED PHOSPHATES. R. F. C. Claridge and A. G. Maddock (University Chemical Lab., Cambridge, Eng.). Trans. Faraday Soc., 59: 935-46(Apr. 1963).

A study of the neutron irradiation of a number of phosphates was carried out using paper electrophoresis for the separation of the products. The processes of thermal and radiation annealing were examined and by using low-temperature neutron irradiations a more complete picture of these processes was established. Chemical and paper electrophoretic separations were found to give comparable results. A limiting wavelength for photo-annealing is reported. Mechanisms for the annealing reactions are proposed and the identities of the metastable fragments are discussed. (auth)

23420 POLAROGRAPHY OF TRYPSIN IN THE PRESENCE OF A SUBSTRATUM AND AN INHIBITOR DURING IRRADIATION WITH ULTRA-VIOLET LIGHT. I. D. Ivanov, E. E. Rakhleeva, and V. G. Krylova (Bakh Inst. of Biochemistry, Academy of Sciences, USSR). Ukr. Biokhim. Zh., 34: 678-87(1962). (In Russian)

The two-stage polarographic wave and the catalytic activity of trypsin were investigated in the presence of the substratum and an inhibitor diisopropylfluorophosphate (DFP) in the process of irradiation with ultraviolet light. An increase in the height of the first stage of the wave (h_1) and the displacement of the hydrogen generation potential on the cathode to the region of more positive potentials is explained by the transition of the molecule from the alpha to the beta configuration of the enzyme under the influence of ultraviolet rays. The substratum (gelatin) increases the sensitivity of the enzyme to disintegration of the globule under the influence of ultraviolet rays and decreases the h_1 of the trypsin wave before irradiation. DFP has a slight effect on the h_1 and on the displacement of the hydrogen

generation potential. DFP inhibits the formation of complexes of Co and trypsin. The trypsin molecule is stabilized on raising the concentration to 80 γ/ml, which affects both the h_t of the wave and the catalytic activity of the enzyme. (auth)

23421 POLAROGRAPHIC WAVE AND CATALYTIC ACTIVITY OF CHYMOTRYPSIN IN THE PRESENCE OF A SUBSTRATE, INHIBITOR AND DNA IN THE PROCESS OF IRRADIATION WITH ULTRAVIOLET LIGHT. I. D. Ivanov, E. E. Rakhleeva, and V. G. Krylova (Bach Inst. of Biochemistry, Academy of Sciences, USSR). Ukr. Biokhim. Zh., 34: 853-62(1962). (In Russian)

The two-step polarographic wave of chymotrypsin and serum albumin was investigated in connection with the appearance of the first and second steps of the wave. An attempt is made to explain the significance of the drop in height of the first and the rise in height of the second step of the wave during the process of detorsion of protein globules under the effect of ultraviolet light. The available data permit judging the selective destruction of the tertiary structure of the enzyme molecule, also indicated by the vanishing of its catalytic activity. The polarographic method may be used when solving a number of problems on the transition of the protein molecules from the α- to the β-configuration. A study was also made of the effect of the substrate, inhibitor (diisopropyl fluorophosphate), and DNA on the height of the wave and the catalytic activity of the enzyme during the transition from the α- to the β-configuration. (auth)

23422 THE HEAVIEST ELEMENTS CURIUM AND TRANSCURIUM ELEMENTS. Mieczyslaw Taube (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Wiadomosci Chemi., 17: 69-90(Feb. 1963). (In Polish)

A survey of the chemical and nuclear properties of curium and transcurium elements was made, and the possibility of synthesizing transnobelium elements was discussed. (auth)

23423 TYAZHELYE IZOTOPY VODORODA: DEITERII I TRITII. (Heavy Hydrogen Isotopes Deuterium and Tritium). I. F. Tupitsyn. Moscow, Gosatomizdat, 1961. 38p.

Descriptions are given of preparation, determination, and properties of deuterium and tritium. The preparation of chemical compounds and applications of hydrogen isotopes as tracers in industry and medicine are discussed. Safety measures in handling tritium are also considered. (R.V.J.)

23424 POLYMERIC LUBRICATING OIL ADDITIVES. James F. Black and Donald A. Guthrie (to Esso Research and Engineering Co.). U. S. Patent 3,089,832. May 14, 1963. Filed Aug. 1, 1956.

A method is given for forming graft copolymers from a mixture of a polymer and a polymerized monomer by exposure to ionizing radiations. The method is especially applicable to the preparation of oil-soluble polymeric products. In this application, a mixture of polyisobutylene and a monomer is irradiated with 10^5 to 10^7 r. The monomers which may be used are listed. (D.L.C.)

Raw Materials and Feed Materials

23425 (NLCO-870) SUMMARY TECHNICAL REPORT FOR THE PERIOD JANUARY 1, 1963 TO MARCH 31, 1963. (National Lead Co. of Ohio, Cincinnati). May 10, 1963. Contract AT(30-1)-1156. 92p.

A semicontinuous ion exchange column was used for the pilot-scale production of purified uranyl chloride solutions from scrap leach liquor. Continuous box mixer-settler tests demonstrated that an Aliquot-336–Solvesso 100 system will satisfactorily extract uranium from scrap leach liquor. An airless shot blaster is being used to clean slag from debries using uranium shot as the blasting medium. Plasma-spraying equipment was installed for coating graphite crucibles and molds with refractory materials. Production-size uranium ingots having fine, evenly dispersed inclusions were produced by consumable-electrode arc melting under vacuum. Variations in uranium billet temperatures prior to rolling were found to affect the amount of recrystallization and the texture coefficients in the alpha-rolled rods. Four HAPO I and E fuel cores that were beta treated and water quenched were examined for texture gradients. G_2, G_3, and J data are tabulated. Uranium phosphide inclusions were identified in production-grade derby metal of high phosphorus content. (auth)

23426 (TID-16176) FLUID BED FLUORINE CLEANUP REACTOR. (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1962]. Contract [W-7405-eng-26]. 2p.

The design of a fluid bed fluorine recovery system to improve fluorine utilization in the production of UF_6 feed material for a diffusion cascade is presented. The process utilizes a 27-in. dia Monel reactor operating at a pressure of 10 to 14 psia. The reactor is fed UF_4 at a rate well in excess of the stoichiometric rate to enhance fluorine recovery. A constant bed height of $4\frac{1}{2}$ ft is ensured by the location of the solids overflow line. (P.C.H.)

23427 DECANTATION METHODS USED IN THE HYDROMETALLURGY OF URANIUM. I. A. Yakubovich. At. Energy. (USSR), 14: 206-12(Feb. 1963). (In Russian)

Extraction, sorption, and electrochemical methods for leaching out the desired components may be employed both for clarified solutions and for technical suspensions or pulps. Decantation processes involving strong flocculating agents for accelerating the sedimentation have acquired importance; they are used primarily for the hydrometallurgical separation of the soluble materials from the deposits in the pulps. The applicability of a specific method can be determined only by detailed cost calculations; the results of such calculations are often used to determine whether to start the process directly with the pulp or carry out a preliminary clarification first. Equations were derived for solving problems presented by the design of countercurrent washing processes for the separation on an industrial scale of the soluble materials from the deposits. The quantities of industrial solvents required for optimum efficiency may be obtained by solving analytically or graphically the stage equations. Construction of nomograms from the equations given will greatly simplify the necessary calculations. (TTT)

23428 THE OXIDATION OF SULPHUR DIOXIDE AND THE FORMATION OF SULPHURIC ACID IN SITU AT ATMOSPHERIC PRESSURE IN THE LEACHING OF A URANIUM ORE. D. E. Light, T. Szaplonczay, E. J. Nurse, and G. B. Hudson (Queen's Univ., Kingston, Ont.). Can. Met. Quart., 2: 73-87(Jan.-Mar. 1963).

The oxidation of sulfur dioxide to form sulfuric acid in situ, at atmospheric pressure and temperatures from 25 to 80°C, was examined by passing a mixture of sulfur dioxide and air for 7 hours through a reaction vessel containing quartz- or uranium-bearing solids moistened with water to 85% solids. At the end of the contact period the solution was analyzed for free acid and other constituents in order to determine the extent of oxidation of sulfur di-

oxide and extraction of uranium. In tests with quartz at 80°C, the addition of ferric sulfate or ferric oxide increased the amount of sulfur dioxide converted to sulfuric acid. For example, without ferric sulfate added to the conversion obtained was 2%; with 0.7 and 2.3 lb/ton quartz of ferric sulfate the conversions were 18 and 24%, respectively. (auth)

23429 PROCESS FOR THE SELECTIVE RECOVERY OF URANIUM DIRECTLY FROM URANIUM-BEARING ORES. Jurgen M. Kruse (to E. I. du Pont de Nemours and Co.). U. S. Patent 3,089,885. May 14, 1963. Filed June 23, 1959.

A simple process is outlined for the high recovery of U from low-grade U ores. The process comprises contacting the ore at pH 3 to 9 with a solution of an organic polydentate liquid in a nonaqueous organic solvent, in order to selectively leach the U. The amount of solution used is proportional to the amount of U to be recovered and not to the total amount of ore. Two polydentates which may be used is salicylic acid and uncrosslinked salicylic acid-formaldehyde polymer, and others are listed. Several examples of the process are given. (D.L.C.)

Separation Processes

23430 (BM-RI-6242) YTTRIUM BEHAVIOR IN RARE EARTH–AMINE EXTRACTION SYSTEMS AND EFFECT OF SEQUESTRANTS. D. J. Bauer and A. C. Rice (Bureau of Mines. Reno Metallurgy Research Center, Nev.). Oct. 1962. 19p.

Solvent extraction techniques were used to determine the extraction sequence of Y and the rare earth elements in an amine solvent extraction system. Single-stage extraction with Primene 81-R resulted in separation factors of 3.8 between Y and Dy and 25 between Y and Ce. Yttrium was concentrated in the aqueous phase. EDTA and DTPA, as aqueous phase counterextractants, enhance separation factors in amine–rare earth sulfate systems. Yttrium separation from heavy rare earth elements exhibits marked sensitivity to the position of Y in the selectivity scale of the rare earth elements with the sequestrants. Yttrium–Yb separation is more effective with EDTA, whereas Y–Dy separation is more effectively increased with DTPA. (auth)

23431 (IDO-14606) EFFECT OF ALLOYING CONSTITUENTS ON ALUMINUM DISSOLUTION RATES. R. D. Fletcher, M. E. Jacobson, and H. R. Beard (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 15, 1963. Contract AT(10-1)-205. 31p.

In studies of the effect of alloying elements on the rate of dissolution of Al in mercury-catalyzed nitric acid, it was observed that Co, Ni, and Si present at concentrations of 1 to 2% have significant passivating effects. Fe was slightly catalytic. Passivation due to Si was partly overcome by contacting the passive alloy with active, high-purity Al. Increased catalyst concentration improved the rates when Ni and Si were present. Neither approach was effective when Cu was the passivating element. For application to nuclear fuel reprocessing, it is suggested that for minimum reprocessing costs the potentially passive Al alloys not be used in fuel elements or that, failing this, electrochemical activation techniques be applied at the processing plant. (auth)

23432 (JAERI-1047) DATA OF INORGANIC SOLVENT EXTRACTION. [PART] I. Tomitaro Ishimori and Eiko Nakamura, eds. (Japan Atomic Energy Research Inst., Tokyo). 1963. 40p.

A summary of data is presented on the behavior of about sixty elements in some twenty-one solvent extraction systems. Acid dependence curves arranged according to the sequence of the periodic table are included. (J.R.D.)

23433 (MITNE-31) EQUILIBRIUM EXTRACTION CHARACTERISTICS OF ALKYL AMINES AND NUCLEAR FUELS METALS IN NITRATE SYSTEMS. Progress Report No. 11, April 1–December 31, 1962. Edward A. Mason and Takashi Watanabe (Massachusetts Inst. of Tech., Cambridge). Apr. 1, 1963. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26; Subcontract 1327. 31p.

The following variables were studied in connection with the investigation of the extraction of niobium from nitric acid solution by alkyl amines: the distribution ratio of niobium as a function of both amine and nitric acid concentration for Primene JMT in toluene; the distribution ratio as function of contact time for Primene JMT in toluene; and the effect of diluent on niobium extraction by Primene JMT. It was found that the distribution ratio of niobium is greater than 10 for high acid and amine concentrations. There was a very strong dependence of distribution ratio on nitric acid concentration in the range of 8 to 12N. There was also a marked dependence of distribution ratio on contact time. There is no significant effect of aqueous aging and the effect of different diluents was small. The previous work on the extraction of nitrato complexes of nitrosylruthenium by the tertiary amine, TLA, was extended to include studies with the primary amine, Primene JMT, and the quaternary amine, Aliquat Q-336. At low concentrations of HNO_3 (2N) the order of decreasing ruthenium extraction was found to be Q-336, TLA, and JMT. At high HNO_3 concentration (9N) Primene JMT had the highest ruthenium extractability. Rapid dilution experiments were carried out with TLA and Q-336. The results plus those of the earlier TLA studies were analyzed using an IBM 7090 to determine the number and aqueous phase concentrations of extractable species of ruthenium and the amine partition coefficients for these species. In accord with the earlier work, two extractable species were found. The mole fractions found in the TLA and (Q-336) experiments agreed (as predicted by the assumed model) and were found to increase with increasing HNO_3 concentration. The partition coefficients of Q-336 were found to be about an order of magnitude greater than those of the tertiary amine. Limited studies in the effect of partial uranium saturation of TLA on the extraction of zirconium and nitrosylruthenium nitrato complexes were carried out at 25°C in 7N and 9N HNO_3 using 0.3M TLA in toluene. There was considerable scatter in the limited results obtained which can be represented by $E_A^0(\text{metal}) = Ae^{-0.02\,3U} \pm 40\%$ where U = organic phase uranium concentration (gm/l) and the constant A varies with the metal specie and nitric acid concentration. (auth)

23434 (ORNL-3404) DEMONSTRATION OF THE ZIRFLEX AND SULFEX DECLADDING PROCESSES AND A MODIFIED PUREX SOLVENT EXTRACTION PROCESS, USING IRRADIATED ZIRCALOY-2 AND STAINLESS-STEEL-CLAD URANIA SPECIMENS. J. H. Goode, M. G. Baillie, and J. W. Ullmann (Oak Ridge National Lab., Tenn.). May 23, 1963. Contract [W-7405-eng-26]. 80p.

The Zirflex and Sulfex processes for chemical decladding Zircaloy or stainless-steel-clad UO_2 power reactor fuels were successfully demonstrated at irradiation levels as high as 28,200 Mwd/t. The Zircaloy jackets were dissolved in boiling 6 M NH_4F–1 M NH_4NO_3, and the stainless steel

jackets were dissolved in refluxing 4 M H_2SO_4. Both processes gave average soluble losses of uranium and plutonium to the decladding reagents of about 0.05%. Centrifugation or filtration of the highly radioactive decladding waste solutions was required to recover UO_2 fines produced by fracture of the UO_2. The fines were recycled and dissolved with the UO_2 cores in boiling 4 M HNO_3 solution. About 5 to 6 hr were required for complete dissolution of the UO_2 core to produce terminal concentrations of 100 g of uranium per liter and 3 M HNO_3. The core solution was a suitable solvent extraction feed after clarification and adjustment of plutonium valence with sodium nitrite. One cycle of the modified Purex process, in Mini mixer-settlers, using 100-g-uranium-per-liter feed solutions, gave losses of uranium and plutonium to the raffinate of less than 0.1%, and gross gamma decontamination factors of about 1.5×10^4 for the uranium product and about 5×10^3 for the plutonium product. High purity n-dodecane diluent for the 30% TBP solvent retarded the formation of non-removable uranium-retaining degradation products in the solvent by factors of up to 20, compared to Amsco-diluted TBP as measured by the uranium content of the washed solvent after six simulated cycles through the modified Purex process. The feed solutions were prepared from fuel specimens irradiated to 13,000 Mwd/t and cooled about 1 year. (auth)

23435 (ORNL-TM-580) HAZARDS AND EXPERIMENTAL PROCEDURE EVALUATION FOR: STUDIES ON THE POLYMERIZATION AND HYDROLYSIS OF PLUTONIUM IN URANYL NITRATE AND NITRIC ACID SOLUTIONS AT ELEVATED TEMPERATURES. R. E. Biggers and D. A. Costanzo (Oak Ridge National Lab., Tenn.). May 22, 1963. Contract [W-7405-eng-26]. 29p.

The polymerization of Pu is briefly reviewed and an experimental program that will provide some data on the polymerization of Pu in the $UO_2(NO_3)_2-HNO_3$ system and other aspects of the problem are discussed in detail. A detailed description of the facilities set up for the investigation is presented and the mode of operation is discussed. The overall program is evaluated from the point of view of hazard, health physics procedures, and personnel safety. (P.C.H.)

23436 (RT/CHI(63)-3) THE EUREX FLOWSHEET: PROCESSING OF IRRADIATED U–Al ALLOYS BY AMINE SOLVENT EXTRACTION. F. Baroncelli, G. Calleri, A. Moccia, G. Scibona, and M. Zifferero (Italy. Comitato Nazionale per l'Energia Nucleare). Jan. 1963. 37p.

The possibility of using long chain tertiary amines as extracting agents in the recovery and decontamination of uranium from irradiated U–Al alloys was investigated. Nitric acid dissolution of MTR type fuel elements yields a solution with a high Al/U molar ratio. Due to the salting out action of aluminum nitrate, uranium is easily extracted from the aqueous phase by a suitable tertiary amine-diluent system; fission products nitrates are much less extractable and good decontamination factors are attainable. Uranium partition coefficients and fission product decontamination factors are influenced by the concentration of nitric acid, aluminum nitrate, and uranyl nitrate. The chemical stability of the amine-diluent system in nitric acid and nitrates is excellent in the experimental conditions of the flowsheet. High exposure rates result in a decreased Zr decontamination without causing retention of U in the organic phase: a suitable solvent clean up restores normal decontamination factors. The Eurex flowsheet is based on two separate extraction cycles: in both cycles the organic phase is 4 vol/% Alamine 336 in an aromatic hydrocarbon diluent. The salting out action in the second cycle is provided by adding aluminum nitrate to the scrub solution. The expected advantages of this flowsheet are connected with the higher selectivity of the amine solvent which permits higher decontamination factor and therefore a reduction of the number of extraction cycles. Savings in equipment, ancillary and analytical services, and hot cell space will lower both capital and operating costs. Based on the Eurex flowsheet a small size plant will be constructed to process MTR type fuel assemblies. (auth)

23437 (TID-16930) BIDENTATE ORGANOPHOSPHORUS COMPOUNDS AS EXTRACTANTS. I. EXTRACTION OF CERIUM, PROMETHIUM, AND AMERICIUM NITRATES. T. H. Siddall, III (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Oct. 1962]. Contract AT(07-2)-1. 15p.

It is shown that tetraalkyl methylenediphosphonates, dialkyl N,N-dialkylcarbamylphosphonates, and dialkyl N,N-dialkylcarbamylmethylenephosphonates are powerful, chelating extractants for Ce, Pm, and Am from solutions of HNO_3. (auth)

23438 (TID-18604) SOLVENT EXTRACTION OF HALO-COMPLEXES. (Georgia Inst. of Tech., Atlanta). [nd]. Includes Appendices: A. A STUDY OF TIN(VI)–BROMIDE COMPLEXES IN SOLUTION. Vernon Ray Porter. Sept. 1960. B. A SPECTROPHOTOMETRIC STUDY OF MOLYBDENUM(VI) AND MOLYBDENUM(V) IN HYDROBROMIC ACID (thesis). Joe Frank Allen. Sept. 1962. Contract AT(40-1)-2476. 99p.

Activities in a program to increase understanding of halo-complexes of metals into organic solvents are reported. Most of the effort in the program was devoted to establishing the nature of the species existing in aqueous phases. Information is included on Sn(IV)-chlorides and bromides, and on Mo(V), and Mo(VI) bromides. (J.R.D.)

23439 (AEC-tr-5786) FUEL PROCESSING BY A DRY METHOD. II. STUDY OF FLUIDIZED ALUMINA BEDS. M. Bourgeois and G. Manevy (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from a French report. Feb. 1962. 24p.

Fluidization applications in the removal of heat from reactions of gaseous halogen compounds with nuclear fuels such as U–Zr or Mo–U are reported. Particular attention was directed to alumina beds and gases such as Ar, N_2, and HCl. The parameters examined included minimum gas rate required for fluidization, fine particle entrainment, effectiveness of methods for separating entrained particles, effects of bed geometry, particle dimensions, gas properties and temperature, and the presence of solid bodies in the bed. (J.R.D.)

23440 (AEC-tr-5813) ION EXCHANGERS. A SURVEY OF THEIR CHARACTERISTIC PROPERTIES. Milan Marhol. Translated for Los Alamos Scientific Lab., N. Mex. from Chem. Listy, 56: 728-62(1962). 36p.

A collection of the properties of the most diverse types of ion exchangers is presented. The survey is in the form of tables and is divided into the following sections: strongly and weakly acid cation exchangers, strongly and weakly basic anion exchangers, nonstandard types, mixed-bed types, special types, liquid types, ion-exchanger membranes, ion-exchanger papers, ion-exchanger cellulose derivatives, ion-exchanger Sephadex derivatives, inorganic types, sulfonated carbons, equivalence of various varieties, and chemical properties. (N.W.R.)

23441 THE STATE OF RESEARCH ON REMOTE MANIPULATION DURING IRRADIATED FUEL TREATMENT. J. Stratakis. Bull. Inform. Sci. Tech. (Paris), No. 68, 37-42(Jan. 1963). (In French)

The research on remote manipulation during fuel treatment can be summarized as follows: trying-out of various manipulators, search for tools which can be held by a manipulator, and adaption of the treatment equipment for operation at a distance. Two main types of manipulators were tried out at the SETCI: electro-mechanical and hydro-mechanical. Two tools were investigated for tightening screws and nuts: the pneumatic shock spanner and a motorized screw-driver. The development of a metallic jointed coupling which can be remotely controlled was finished. All the parts of the coupling are made of stainless steel. In a production factory designed for remote control the setting up of the material in interchangeable racks appears to be an attractive solution. Studies for the development of such racks were begun. (auth)

23442 PILOT PLANT FOR IRRADIATED FUEL TREATMENT. DESCRIPTION AND GENERAL CHARACTERISTICS. H. Guillet. Bull. Inform. Sci. Tech. (Paris), No. 68, 43-51(Jan. 1963). (In French)

The general characteristics of the pilot plant for treatment of irradiated fuels are described. Its construction and operation are discussed. Analytical control and maintenance of the installation are also described. (auth)

23443 SEPARATION METHODS FOR PLUTONIUM. Ansgar Schiffers. Chemiker-Ztg., 86: 845-51(Dec. 5, 1962). (In German)

The methods and techniques used for the separation and preparation of Pu are summarized. The difficulties of each method and the techniques used to avoid or negate them are described. 57 references. (J.S.R.)

23444 SOLVENT EXTRACTION OF URANYL THIOCYANATE COMPLEX. [PART] I. Tsai-Teh Lai and Han-Ton lin (Cheng Kung Univ., Tainan, Taiwan). J. Chinese Chem. Soc. (Taiwan), 8: 327-33(Dec. 1961).

A systematic study of the extraction behavior of uranyl thiocyanate with a mixture of isoamyl alcohol and ethyl acetate is described. The ratio of isoamyl alcohol to ethyl acetate, extraction time, concentration of thiocyanate, and effect of pH were investigated. The extractability of U increases sharply with an increasing percentage of isoamyl alcohol in the mixed solvent and reaches a plateau of maximum extractability of 96.5% when the isoamyl alcohol to ethyl acetate ratio range is 1:2 to 1:6. The percentage extraction of U by ethyl acetate alone was 67.8 and that by isoamyl alcohol alone 78.7. Since uranyl ion forms a simple coordination complex with thiocyanate ion, it was expected that equilibrium is established at an extremely rapid rate during the extraction, and the results showed that the extraction equilibrium is accomplished within 1 min. Maximum extraction of 96.5% U was attained when the concentration of thiocyanate was 1 to 3M. When the pH value of the solution to be extracted was varied from 0.1 to 5.3 it was found that below pH 1.0 the extractability of U increases with increasing pH and reaches a constant value of 96.5% at pH values between 1.0 and 3.0. Beyond pH 3.0 the extractability of U decreases. (H.H.D.)

23445 THE EXTRACTION OF URANIUM(VI) FROM NITRIC ACID SOLUTIONS BY DE-(2-ETHYLHEXYL)-PHOSPHORIC ACID. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). J. Inorg. Nucl. Chem., 25: 109-15(Mar. 1963).

The partition of uranium (VI) between nitric acid solutions and solutions of di-(2-ethylhexyl)-phosphoric acid (DEHPA) in kerosene was investigated under varying conditions. Changes in acidity of the organic solutions were measured and infrared spectra of the organic phases obtained. The mechanism of extraction is discussed in the light of the results obtained. (auth)

23446 COUNTERCURRENT EXTRACTION OF THE RARE-EARTH ACETYLACETONATES. W. B. Brown, G. W. Pope, J. F. Steinbach, and W. F. Wagner (Univ. of Kentucky, Lexington). J. Inorg. Nucl. Chem., 25: 429-39 (Apr. 1963). (In English)

The countercurrent distribution behavior of the rare-earth acetylacetonates in different solvent systems was studied. Solubilities of the chelates in various solvents were determined in order to obtain data on the partition coefficients. The hydrated rare-earth acetylacetonates hydrolyze upon dissolving in benzene. Excess acetylacetone prevents hydrolysis and lowers the solubility of the chelates in the organic phase. A four-component system using acetylacetone, chloroform, methanol, and water was developed. The acetylacetone in the chloroform phase suppressed hydrolysis and the methanol in the aqueous phase increased the solubilities of the chelates by a factor of ten over the solubilities in the water-acetylacetone system. (auth)

23447 THE EXTRACTION OF URANIUM(VI) FROM SULPHURIC ACID SOLUTIONS BY TRI-N-OCTYLAMINE. Taichi Sato (Government Chemical Industrial Research Inst., Tokyo). J. Inorg. Nucl. Chem., 25: 441-6(Apr. 1963). (In English)

The partition of uranium(VI) between sulphuric acid solutions and solutions of tri-n-octylamine (TOA) in benzene was investigated at varying concentrations of sulphuric acid, solvent, and uranium and at different temperatures. The extraction of sulphuric acid and the water content of the organic phase was also examined, and infrared spectral studies made of the organic solutions. The mechanism of uranium extraction is discussed on the basis of the results obtained. (auth)

23448 LABORATORY STUDIES ON THE CHLORINATION WORK ON NEUTRON-IRRADIATED URANIUM NUCLEAR FUELS. PART 3. PLUTONIUM SEPARATION BY GAS CHROMATOGRAPHY OF THE CHLORIDE VAPOR ON CHARCOAL. D. Naumann (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 116-21(Mar. 1963). (In German)

By means of gas chromatography of the anhydrous chloride vapors of uranium, plutonium, and fission products on charcoal at 700°C, an unobjectionable uranium–plutonium separation as well as a separation of plutonium from the principal part of the fission products were achieved. The behavior of plutonium chloride and the most important fission-product chlorides in carbon dioxide was investigated. (tr-auth)

23449 REPROCESSING OF UO_2-DISPERSED GRAPHITE FUEL. I. AN APPROACH TO THE MECHANICAL RECOVERY OF URANIUM DIOXIDE. Kazumi Iwamoto and Junichi Shimokawa (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 272-9(Apr. 1963). (In English)

An approach to recover UO_2 mechanically from the UO_2-graphite fuel specimen was investigated. After disintegrating an unirradiated specimen by a pulverizer, ball mill, or micron mill, the obtained powder was separated into the UO_2 and graphite phases by a heavy-media-separation method in which a zinc bromide solution was used as the

heavy medium. The disintegration of the specimen into fine powder was essential for the mechanical separation of UO_2. Additional treatments such as preoxidation of the sample, addition of dispersion agent to the zinc-bromide solution, and irradiation of the solution with the ultrasonic waves, were not effective in improving the UO_2 recovery. However, it seemed that the grinding method coupled with continuous removal of the ground particles with fluid flowing would be effective in obtaining a high UO_2 recovery. (auth)

23450 FUEL CYCLE TECHNOLOGY. M. Benedict (Massachusetts Inst. of Tech., Cambridge). Nippon Genshiryoku Gakkaishi, 5: 335-9(Apr. 1963). (In Japanese)

The fuel cycle costs and flowsheets for various reactor types, including pressurized water and light and heavy water reactors, are surveyed. (L.T.W.)

23451 CHEMICAL STUDIES ON RADIOACTIVE INDICATORS. XXII. THE SEPARATION OF CARRIER-FREE RADIOACTIVE RHENIUM. Masayoshi Ishibashi, Taichiro Fujinaga, and Mutsuo Koyama (Kyoto Univ.). Nippon Kagaku Zasshi, 82: 185-7(Feb. 1961). (In Japanese)

Radioactive Re was produced by the W(p,n)Re reaction in a cyclotron and separation of the carrier-free and salt-free Re was investigated. After cooling for 1 month, Re^{184} was the main radioactive nuclide. The W target was fused with KOH and then dissolved in water, and Re^{184} was separated out in a 4 N KOH solution by extracting it with pyridine. The pyridine layer was evaporated and the residue was dissolved in water. The remaining K^+ was removed by cation exchange. More than 70% of Re^{184} was recovered with this simple procedure. The radioactive impurity in the target was separated and identified as Co^{58}. (OID)

23452 SEPARATION OF IRRADIATION PRODUCTS OF SODIUM CHLORIDE ON THE IRON HYDROXIDE COLUMN. H. W. Kohlschuetter and H. H. Stamm (Technische Hochschule, Darmstadt, Ger.). Z. Anorg. Allgem. Chem., 320: 112-16(Jan. 1963). (In German)

Chemical treatment of NaCl that was irradiated in a neutron flux led to a mixture with a great excess of Cl^- and tracer amounts of SO_4^{2-} and PO_4^{3-}. This mixture of anions can be separated in a column with iron hydroxide. (auth)

23453 LIQUID-LIQUID CONTACTING APPARATUS. Maurice Charles Tanner (to United Kingdom Atomic Energy Authority). U. S. Patent 3,089,756. May 14, 1963. Priority date Jan. 10, 1957, Great Britain.

A mixer-settler apparatus with alternate mixer and settler compartments is designed. Overflow and underflow weirs are provided for permitting mixed phase flow from mixer compartments in both directions, light phase flow from settler compartments in one direction, and heavy phase flow in the other direction. (D.L.C.)

23454 CONCENTRATION OF RARE EARTHS. Paul R. Kruesi (to Vitro Corp. of America). U. S. Patent 3,089,758. May 14, 1963. Filed Apr. 18, 1960.

A process is given for concentrating Eu in rare-earth chloride solutions obtained from monazite. In the process, the solution is heated to 157 to 162°F until the specific gravity is 1.83 to 1.87 and cooled slowly to 122 to 125°F in 10 to 13 hr to form "cold crystals" which are separated from the solution. The solution is then heated again to 160°F until a specific gravity of 1.85 to 1.92 is obtained, and "hot crystals" are separated from the solution at constant temperature. The "cold crystals" are enriched in the light rare earths Ce and La, while the "hot crystals" are enriched in the heavier rare earths, e.g., Eu. The Eu concentration in the "hot crystals" is more than twice that of the feed liquor. (D.L.C.)

23455 CONCENTRATION OF RARE EARTHS. Hugh J. Bronaugh and Paul R. Kruesi (to Vitro Corp. of America). U. S. Patent 3,089,759. May 14, 1963. Filed Apr. 18, 1960.

A process is given for concentrating rare earth elements, particularly Eu. The process comprises heating a solution of rare earth chlorides at 190 to 203°F until a specific gravity of 1.85 to 1.92 is achieved, cooling the solution to 140 to 160°F in 1 to 3 hr to cause crystallization, and immediately separating the crystals from the solution. The rare earths with atomic numbers >59 and including Y are enriched in the crystals, while the lighter rare earths La and Ce are concentrated in the mother liquor. Several examples of the process are given. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 24640, 24709, and 24732.

23456 (59GL235) DESCRIPTION AND EVALUATION OF "HANDYMAN" SERVO MANIPULATOR, GEL-II. R. S. Mosher (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Oct. 5, 1959. 34p.

Servo-manipulator, Model GEL-II, was designed to be dexterous, strong, and have spatial correspondence and force reaction to the operator. The master and slave are wire connected only. Detailed information on analysis and design is available. This machine is effective in performing the tasks for which it was designed. (auth)

23457 (ACNP-63013) STEAM SEPARATION TECHNOLOGY UNDER THE EURATOM PROGRAM. Quarterly Progress Report, January 1, 1963–March 31, 1963. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Apr. 10, 1963. Work Performed under United States–Euratom Joint Research and Development Program. 123p (EURAEC-624)

For purposes of analysis and experiment the centrifugal type downflow separator was divided into the inlet nozzle, separating zone, and outlet nozzle. The analysis and experiments have resulted in a new outlet design, a method of determining separating length, and a more effective inlet nozzle. The results have caused a reduction in pressure loss from 5 ft of water for the reference design to 1.5 ft of water for the new design at a flow rate of 1400 gpm. A reactor core riser and downcomer region was mocked-up in the large air-water tank. Void fraction in the downcomer region was measured as a function of water velocity, water temperature, inlet gas flow rate, and riser geometry. Results show that the void fraction in the downcomer is essentially zero until a threshold downcomer velocity is reached. The void fraction then rises rapidly with increasing water velocity to approximately 11% and then appears to remain constant. Test data from this experiment are being correlated using a dimensional analysis technique. An initial prediction equation was developed. (auth)

23458 (ARF-3216-4) CONTAMINANT EFFECTS STUDY. A. Lieberman (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 9, 1962. For Sandia Corp., Albuquerque, N. Mex. Contract AT(11-1)-578. 46p. (SCDC-3101)

A description and evaluation of the variables affecting contamination of precise devices are presented. These variables are correlated as far as possible. Extended definitions are given for the parameters shown in Report ARF 3216-1 and Report ARF 3216-2. The variables are discussed in detail, and the basis for their inclusion is given. The device properties and operations which can be affected by contamination are described along with the mechanisms by which contaminants affect the properties or operations of interest. The properties of contaminants and the sources of contamination including some descriptions of the contamination process are also described. Possible correlations between device characteristics and contaminant characteristics are discussed. (auth)

23459 (ARF-3216-5) CONTAMINANT EFFECTS STUDY. Final Report. A. Lieberman (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 14, 1962. For Sandia Corp., Albuquerque, N. Mex. Contract AT(11-1)-578. 99p. (SCDC-3102)

Work done on a program, the objectives of which include evolution of analytical research to evaluate the effects of environment-contributed contamination on precise devices is described. In order to permit evolution of such a program, it was necessary to define and evaluate the variables involved in contamination of precise devices in such a manner as to permit description of techniques designed to define their relative importance. During the course of the work, it was found necessary to carry out literature surveillance as well as theoretical and experimental research. (auth)

23460 (GD/C-63-068) DEVELOPMENT OF A HIGH-TEMPERATURE, NUCLEAR-RADIATION-RESISTANT PNEUMATIC POWER SYSTEM FOR FLIGHT VEHICLES. Quarterly Report, December 25, 1962 and March 24, 1963. (General Dynamics/Convair, San Diego, Calif.). Mar. 24, 1963. Contract AF33(616)-7582. 36p. (AD-400324)

The experimental development of components for the high-temperature pneumatic system is continuing. Preliminary experimental development of the compressor (Phase I) is complete. Testing of the gas-lubricated journal bearing at speeds of 71,400 rpm (surface velocity of 7,030 in./sec) is reported. The original concept of a high speed centrifugal compressor, using gas bearings, is found feasible. In addition, one actuator and servo valve is currently undergoing testing. Three accumulators were welded successfully using the electron beam process. However, the development of a satisfactory pressure regulator has suffered another setback as a result of a ruptured bellows assembly. (auth)

23461 (NYO-10151) STRESSES AT NOZZLE CONNECTIONS OF PRESSURE VESSELS. Quarterly [Report], January 1, 1963–March 31, 1963. Donald E. Hardenbergh and Sam Y. Zamrik (Pennsylvania State Univ., University Park). Apr. 26, 1963. Contract AT(30-1)-1874. 21p.

The experimental stress analysis on outlet R on the exterior surface was completed. The tests included a study of the internal pressure, longitudinal bending couple, transverse bending couple, and thrust. Outlet S was tested under internal pressure. Results of the tests are tabulated and the locations of strain rosettes are illustrated. (P.C.H.)

23462 (NYO-10588) STUDY ON THE MECHANICAL WORKING CONDITIONS OF NUCLEAR MATERIALS AS RELATED TO ROLLING. First Quarterly Report. C. A. Martinez Vidal and J. A. Sabato (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). May 1962. 19p.

The design, construction, and adjustment of Siebel conical and Ford plane strain compression dies are reported. The information is given to obtain the true and constrained yield stress curves in nuclear materials. (auth)

23463 (UCRL-10326) MULTIPURPOSE BALL VALVES. William L. Pope (California. Univ., Berkeley. Lawrence Radiation Lab.). June 22, 1962. Contract W-7405-eng-48. 11p.

Modifications of ball valves to permit new applications are described. The valves are of two basic types. One type has a relief valve in the ball for fail-safe operation, without a parallel-flow circuit. The second group incorporates various flow-control elements between the series

ball seals. A side access port is provided to permit control-element removal without system shutdown. (auth)

23464 (WAPD-230) A NUMERICAL SOLUTION FOR PLATE BENDING PROBLEMS. D. S. Griffin (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1963. Contract AT(11-1)-Gen-14. 52p.

A method is presented for obtaining the deflections of a thin elastic plate due to a transverse load and a combination of four boundary conditions including elastic supports. The method, based on finite differences, makes efficient use of the digital computer in solving for the irregular boundary shapes often encountered in engineering design. Results are compared with known solutions, and a new solution is presented. (auth)

23465 POWER SOURCE FOR A 1-kw ARC ENGINE TEST CAPSULE. R. J. Boehme and E. H. Cagle (National Aeronautics and Space Administration, Huntsville, Ala.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 1168-9(May 1963).

The potential application of arc jet engines for propulsion in space is linked closely with the type and characteristics of the power supply available. A power supply designed to power a 1-kw arc engine for use with the Scout Electric Rocket Test (SERT) program is discussed. The most significant features of the power supply are the excellent control, stability, increased engine life, and efficiency. Data obtained from actual arc engine tests are included. The conclusions drawn are based on preliminary analysis of prototype engine and power supply test runs. Although the feasibility of the system has been demonstrated, the development is not considered complete. (auth)

23466 COMPARISON OF CASCADE GENERATOR CIRCUITS. G. I. Kitaev. At. Energ. (USSR), 14: 213-15(Feb. 1963). (In Russian)

Comparison of symmetrical, two-phase, and three-phase circuits with the one-phase, one-half-period Cockroft-Walton circuit revealed the great advantages presented by the multiphase system for use with high-voltage sources. The optimum number of cascades of the symmetrical scheme is larger while the voltage is smaller by a factor of 4. This work was continued, comparing the efficiency from the points of view of pulsing, voltage drop, and number of cascades. The results showed that the three-phase, two-half-period circuit is the most efficient and it is recommended for high-power installations; the ordinary three-phase circuit is less efficient. (TTT)

23467 THE STRICT SOLUTION OF THE ELASTIC DEFORMATION OF A ROTATING HOLLOW SPHERE. Ch. Kuehne (Askanie-Werke, Berlin). Atomkernenergie, 8: 143-6(Apr. 1963). (In German)

The differential equation, transformed into spherical coordinates, of a rotating hollow sphere's elastic deformation was set up and its solution developed. It is shown that a strict solution exists which can be presented in elementary function. From the case of the general hollow sphere, the border cases of the full sphere and of the infinitely thin shell were derived. A numerical example was calculated for a certain hollow sphere, and the result shown in the form of graphic presentations of the individual tension components. (auth)

23468 THE ELECTRONIC CALCULATION OF CIRCUITS OF CLOSED GAS TURBINES WITH GAS-COOLED REACTORS. H. Reimer (Technische Hochschule, Hanover). Atomkernenergie, 8: 147-58(Apr. 1963). (In German)

The systematic performance of circuit computations for closed gas turbines can be considerably simplified by the application of electronic computation methods. The advantages of such a procedure are particularly great if the possible various work media and their real behavior are taken into consideration. This seems to be useful for one-circuit equipment with gas-cooled reactors. The computation of the work process of closed gas turbines can be reduced to a few calculation procedures which are repeated. The real behavior of the media was recorded and such procedures were established and made accessible for electronic computation for the gases helium, nitrogen, and carbon dioxide. By joining these individual calculation programs, a complete computation of the circuit is possible. Complete circuit programs are assembled for some important types of procedures. (auth)

23469 ARMOR. Y. Artur. Bull. Inform. Sci. Tech. (Paris), No. 68, 17-21(Jan. 1963). (In French)

Armor is an α-γ enclosure designed for carrying out various analyses on irradiated fuel samples. It is composed of 8 cells in line. The air-tightness is obtained by plastic boxes connected together by lock-chambers. The protection is provided by a 10 mm thick lead casing. (auth)

23470 FRP GLOVEBOX FOR CHEMICAL RESEARCH. Tomitaro Ishimori (Japan Atomic Energy Research Inst., Tokyo), Kenju Watanabe, Kazuo Tomimura, and Hatsuo Matsumoto. Nippon Genshiryoku Gakkaishi, 5: 325-32 (Apr. 1963). (In Japanese)

A fiberglass reinforced plastic (FRP) glovebox is made for chemical studies of α-emitters after being tested for chemical corrosion, heat and fire resistance, decontamination, mechanical strength, air tightness, and air flow pattern. The FRP box shows very good chemical resistance for many reagents except concentrated sulfuric acid, acetone, and chloroform. The body of the box shows enough resistivity for fire accidents owing to the collapse of a beaker containing 100 to 200 ml of organic solvent such as TBP, toluene or diethyl ether. However, the fire test also indicates that the function of glovebox is often lost by breakdown of attachments such as air filter, glove, and exhaust pipe. (auth)

23471 AN IMPROVED APPARATUS FOR THE VACUUM DEPOSITION OF RADIOACTIVE MATERIALS. W. Parker and Y. Grunditz (Uppsala Univ.). Nucl. Instr. Methods, 22: 73-6(Mar. 1963). (In English)

An apparatus for the vacuum deposition of radioactive materials is described. The apparatus, an improved version of an earlier model, employs electron bombardment heating as a means of extending the temperature up to more than 3000°C. The backing material holder can be manipulated externally allowing for the preparation of several samples during a single operation and a G-M detector combination is provided for the purpose of controlling the deposition of radioactive material. A simple optical projection system was developed for use when high levels of activity are to be processed. In conclusion the operating procedure, and some of the results obtained, are discussed. (auth)

23472 LARGE-SCALE THERMIONIC POWER GENERATION FROM FOSSIL FUELS. C. V. Barnett (Central Electricity Generating Board, London), D. C. Gore, R. V. Harrowell, and J. K. Wright. Proc. Inst. Elec. Engrs., London), 110: 785-92(Apr. 1963).

A theoretical analysis is made of the use of thermionic diode convertors in electrical power generation from fossil fuels. It is shown that the best way to use such a diode is as a "thermodynamic topper": heat rejected from the diode stage is used in conjunction with a conventional steam generator. Various possible diode schemes are discussed: a diode having a cesium-on-tungsten cathode operating at

about 1150°C shows most promise and should lead to an increase in overall efficiency from about 40% for the steam cycle to about 46% for the combined cycle. (auth)

23473 THE HIGH-INTENSITY RI RADIOGRAPHIC APPARATUS. Sumio Makino, Masaaki Kashiwazaki, and Tadaichi Tsuzuki (Tokyo Shibaura Electric Co., Ltd.). Toshiba Rev., Intern. Ed., 17: 842-6(Aug. 1962). (In Japanese)

A device consisting of 3 major parts and designed to overcome the use of 0.5 to 2 C sources that are time consuming is described. Source container: pellets (1 mm × 1 mm) of 100-C Co^{60} with specific activity of 180 to 190 C/g are sealed in a 5 mm × 8 mm capsule. The container is then mounted on a flexible stand that can be moved perpendicularly from 65 to 160 cm, angularly 180° forward, 15° backward, and 90° left or right. The control panel mechanism consists of switches and is operated by 100-v a-c (50/60 cycles/sec). At a distance of 1 m, fault discriminating power of 1% can be obtained from a 100-mm thick steel plate. The exposure time for film to test iron samples 60 to 120 mm thick is 15 to 100 min (Sakura, R), 1 to 10 min (Sakura, S), 4 to 20 min (Fuji no. 100), or 50 sec to 6 min (Fuji no. 200). (TCO)

23474 A NEW METHOD OF DECONTAMINATING TANKS. I. Sukhomlin and V. Ponomarenko. Voennyi Vestn., 42: No. 11, 109-10(1962).

A device is described for the decontamination of tanks from radioactive matter. It was tested successfully in field conditions. The device consists of an ordinary fueling unit provided with a sprayer. Fuel, or a special decontaminating solution from an outer container, is used as the decontaminating agent. About 30 l of fluid are sufficient for decontaminating one tank in 15 minutes. The fluid is sprayed on the tank under a pressure of 0.7 to 1 atm. When using fuel from an outer fuel tank, the latter must be uncoupled and rolled up to the turret, since the hose of the unit is only 5500 mm long and cannot reach the front of the tank. (OTS)

Heat Transfer and Fluid Flow

Refer also to abstract 24652.

23475 (CUA-NE-26) SIMULATED NUCLEAR REACTOR VIBRATIONAL HEAT TRANSFER. Quarterly Progress Report, August 1, 1962–October 31, 1962. (Catholic Univ. of America, Washington, D. C.). Contract AT(30-1)-2655. 14p.

Progress on the design and construction of vibrational heat transfer test sections is reported. An electrodynamic shaker, at the lower frequencies, and piezoelectric ceramic transducers, at higher frequencies, will provide the vibrations to heated cylindrical tubes. The design of the transducer plates is described. Calibration of a probe for determining the sound pressure level is discussed. (M.C.G.)

23476 (IS-419) TURBULENT MASS TRANSFER IN LIQUID STREAMS. Richard Charles Seagrave and R. W. Fahien (Ames Lab., Ames, Iowa). Aug. 1961. Contract W-7405-eng-82. 140p.

The total mass transfer diffusivity for turbulent pipe flow was represented by a second order tensor with two significant components, the radial mass diffusivity and the axial mass diffusivity. These components were determined as functions of radial position for three Reynolds numbers in the low turbulent range by making a study of the transient diffusion of a dye solution from a point source into water in turbulent pipe flow. Concentration data were obtained as a function of position and time. These data were combined with the results of a steady state experiment to compute the diffusivities from a second order linear partial differential equation. Two solution methods were used: a graphical derivative evaluation procedure, and a method which applies the LaPlace transformation in both time and axial distance. Both methods produce two simultaneous ordinary differential equations which could be numerically integrated to produce the diffusivities. Both the radial and axial diffusivity were found to vary with radial position. The variation of the radial component qualitatively resembles the variation of eddy viscosity in the same system. The axial component was appreciable only in the central or core region of the stream. The average values of both components were found to increase linearly with Reynolds number. The diffusivities could be correlated as functions of position and Reynolds number by expressions which accounted for the effects of the velocity, the velocity gradient, and the boundary layer. The ratio of axial diffusion to bulk flow was found to increase slightly with Reynolds number through the range studied. Eddy diffusion was about one hundred thousand times greater than molecular diffusion. Neglecting the contribution of axial diffusion produces smaller calculated values of the radial diffusivity. The variation of the Peclet and Schmidt numbers in the system was similar. Both quantities decreased with increasing Reynolds number in the range. Although a rough analogy between mass and momentum transport existed, the diffusivities were generally not equal. The Schmidt number varied from a value less than one to a value greater than one across the tube radius. It was found that the position Peclet numbers for both mass and momentum varied similarly with position Reynolds numbers. Both quantities increased near the wall, and approached values given by correlations which have been previously proposed for momentum transport quantities. (auth)

23477 (NAA-SR-Memo-7418) FLOW STABILITY LOOP—NUCLEATE BOILING HEAT TRANSFER WITH SANTOWAX R. F. J. Halfen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 29, 1962. Contract [AT(11-1)-Gen-8]. 11p.

Santowax R forced convection boiling heat transfer experiments were conducted using the Flow Stability Loop. The test section (a 12 ft long, $^9/_{16}$ in. OD, 0.042 in. wall thickness, nickel tube) and instrumentation were the same as used in previous experiments with this loop. Results were compared with the nucleate boiling heat transfer model used in FUGUE, Levy's generalized boiling heat transfer equation. An experimental correlation coefficient, B_L, was determined as a function of pressure. Good agreement was obtained between the experimental temperature differences and the values calculated with the Levy equation using the experimental correlation coefficient. The following ranges of the variables were studied: heat flux, 30,000 to 110,000 Btu/hr ft^2; coolant velocity, 5 to 14 ft/sec; outlet pressure, 15 to 26 psia; wall superheat, 42 to 73°F; and coolant subcooling, 0 to 24°F. In all cases the experimental and calculated wall superheat temperatures agreed within 5°F. (auth)

23478 (SC-4777(RR)) VISCOUS FLOW PAST A ROTATING TRANSLATING BLADE WITH ARBITRARY VELOCITY SUCTION AND SLIP. K. J. Touryan (Sandia Lab., Albuquerque, N. Mex.). May 1963. Contract [AT(29-1)-789]. 63p.

The three-dimensional flow of a viscous fluid over a

rotating translating blade with arbitrary suction applied at the wall is studied. Velocity slip is included as a boundary condition to account for rarefaction effects. Pressure drops are estimated across the blade and the flow patterns studied in the capillaries of the blade wall (filter media). A feasibility study is made for using such a blade as a sampling device on the SAND program. (auth)

23479 (TID-16898) THE MOLECULAR AND HYDRODYNAMICAL EFFUSION OF SATURATED VAPORS FROM THIN-EDGED ORIFICES. K. Douglas Carlson (Argonne National Lab., Ill. and Kansas. Univ., Lawrence); Paul W. Gilles (Kansas. Univ., Lawrence); and R. J. Thorn (Argonne National Lab., Ill.). July 1962. Contract [W-31-109-eng-38]. 16p. (UAC-6698)

The unilateral flow of saturated mercury vapor through a thin-edged orifice into a vacuum is investigated from 3×10^{-6} to 0.19 atm. The rate of flow at pressures below 0.1 mm is proportional to $P/T^{1/2}$ and is given by the molecular effusion equation. At pressures above 7 mm the rate of flow is again proportional to $P/T^{1/2}$ and is intermediate between that for hydrodynamical isothermal and hydrodynamical adiabatic flow. The region between 0.1 and 7 mm is a transition one. The low pressure results demonstrate the appropriateness of the effusion method for thermodynamic purposes. The temperature, pressure, mean free path, and mean-free-path-to-diameter ratios at which the molecular effusion equation no longer describes the rate of flow are given. (auth)

23480 (TID-17792) THE EFFECT OF TRANSVERSE TEMPERATURE GRADIENTS ON THE HEAT TRANSFER AND FRICTION FOR LAMINAR FLOW OF GASES. Technical Report 247-3. Monty E. Davenport (Stanford Univ., Calif. Nuclear Technology Lab.). July 31, 1962. Contract AT(04-3)-247. 118p.

The results of an experimental and analytical investigation of the frictional and heat transfer effects for the flow of gases through heated channels at flow rates such that the flow may be regarded as laminar are described. The treatment is restricted to a consideration of the steady flow of gases through tubes of circular cross section. The fact that the thermodynamic and transport properties of gases depend upon the temperature of the gas requires that a realistic investigation of a gas-flow problem which involves temperature variation include this effect. The analysis differs from the previously existent similar analyses in that, in the present case, a velocity component transverse to the main flow stream is postulated, and the effect of this component is included in the analysis by means of appropriate terms in the governing equations. An approximate equation expressing this transverse flow rate is developed from energy transfer considerations. This result is included in a variable properties analysis of the laminar flow of single component gases through heated, round tubes in a defined quasi-developed flow region, in which axially independent approximate equations are obtained and solved numerically. Since the exact rate of transverse flow is not known, solutions are presented for several reasonable rates, including the limiting solution of constant fluid properties and of zero transverse flow. The principal results of the analysis are the Nusselt numbers, which characterize the heat transfer rates, and the friction factors, which characterize the pressure drop, presented as functions of the ratio of the wall temperature to the mixed-mean temperature of the gas for various postulated transverse flow rates. Experimental data were obtained as follows: A steady metered flow of gas was passed vertically upward through an electrically heated tube of circular cross section. The heated test section was preceded by an unheated entrance section which allowed the velocity profile to develop prior to the beginning of heating. Measurements of inlet gas temperature, test section temperature distribution, test section insulation temperature, gas flow rate, electrical power supplied to the test section, and pressure distribution along the test section enabled the pertinent variables and the characteristic parameters of Nusselt number, Reynolds number, temperature ratio, and friction factor to be calculated. Local convective heat transfer coefficients and local friction factors were measured for helium and nitrogen flowing through this electrically heated, smooth, round tube. Data are reported for a range of Reynolds number from 190 to 2200, surface temperatures to 2320°F, gas temperatures to 2300°F, and temperature ratios to 2.2. A comparison was thus possible between the predicted and measured Nusselt numbers and predicted and measured friction factors. It was predicted by the analysis and verified by the data that the local friction factor increases rapidly with increasing temperature ratio; furthermore, the postulated radial velocity effect is adequate to explain this variation of the friction factor with temperature ratio; whereas, an analysis which neglects this radial velocity component, yet otherwise includes the effect of the temperature dependency of the gas properties; underestimates the friction factor if the temperature ratio is much greater than one. The heat transfer results were less conclusive than the friction factor results, but the data did not contradict the results of the analysis. (auth)

23481 ENTROPY PERTURBATIONS IN ONE-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOW. Roy M. Gundersen (Illinois Inst. of Tech., Chicago). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 969-71(Apr. 1963).

Conditions for particle velocity to be unaffected by the addition of an entropy perturbation in a one-dimensional, initially-centered simple-wave flow subjected to a transverse magnetic field are derived. It is assumed that the density and magnetic induction are constantly proportional. (C.E.S.)

23482 CLASS OF EXACT SOLUTIONS OF NONISENTROPIC, ONE-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOW. Roy M. Gundersen (Illinois Inst. of Tech., Chicago). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 1191-3 (May 1963).

The one-dimensional unsteady motion of an ideal, inviscid, perfectly conducting, compressible fluid subjected to a transverse magnetic field is investigated. (C.E.S.)

23483 THE LAMINAR-TURBULENT TRANSITION FOR FLUIDS WITH A YIELD STRESS. Richard W. Hanks (Oak Ridge Gaseous Diffusion Plant, Tenn.). A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 9: 306-9(May 1963). (TID-16087)

The method for predicting the onset of turbulence was extended to the case of semifluids by means of a linear Bingham model. The method was applied to flow in pipes, concentric annuli, and between parallel plates. The pipe-flow calculations were compared with literature data and found to agree well for N_{He} (Hedstrom number) $< 10^5$. The deviations for $N_{He} > 10^5$ are explained as being due to the inadequacy of the simple model at high N_{He} values. (D.L.C.)

23484 TRANSPORT CHACTERISTICS OF SUSPENSIONS. VII. RELATION OF HINDERED-SETTLING FLOC CHARACTERISTICS TO RHEOLOGICAL PARAMETERS. David G. Thomas (Oak Ridge National Lab., Tenn.). A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 9: 310-16(May 1963).

Both the rheological and the hindered-settling characteristics of small particle size suspensions (0.1 to 50 μ) are primarily determined by the degree of flocculation and the concentration of the suspension. Previous studies have shown that when the laminar shear diagrams are fitted by the Bingham plastic model, the parameters τ_y/ϕ^3 and ϕ^{-1} in η/μ are constants which are proportional to the degree of flocculation. The present study showed that these rheological parameters were proportional to the value of α determined from the hindered-settling measurements (α is defined as the ratio of the volume of fluid immobilized by the floc structure to the volume of solids in the floc structure). The materials studied included suspensions of thorium oxide in water and methanol and of titania, kaolin, alumina, and graphite in water. The particle size range was from 0.40 to 17.0 μ. Values of the attractive force between particles calculated from the rheological and hindered-settling data were in good agreement with each other and with the theoretical values calculated from the Derjaguin-Verwey-Overbeek theory of colloid stability. The good agreement among the different values suggests that the present approach may be generally applicable to a variety of different systems. (auth)

23485 SOME TWO-DIMENSIONAL MAGNETO-FLUID-DYNAMIC FLOWS AT LOW MAGNETIC REYNOLDS NUMBER. J. H. Horlock (Univ. of Liverpool). J. Fluid Mech., 16: 17-32(May 1963).

A study is made of the two-dimensional flow of an inviscid, uniformly conducting fluid in the presence of applied magnetic fields, for the case in which the magnetic Reynolds number (the ratio of induced fields to applied fields) is small but the magnetic force coefficient (the ratio of electromagnetic forces to inertia forces) is of order unity. Perturbations of uniform incompressible and compressible flows through aligned and crossed fields are considered. All these perturbations are strongly dependent upon the magnitude of the magnetic force coefficient. An experimental analogy of the flow through an aligned field is described. (auth)

23486 SURFACE BOILING HEAT TRANSFER STUDIES. István Szentgyoergyi. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 11: 21-45(1963). (In Hungarian)

The general laws governing surface boiling heat transfer, the mechanism of nucleation, and the influence of flow velocity, subcooling, pressure, dissolved gases, heat transfer surface, and low-boiling additives on the rate of heat transfer and burnout are analyzed. The apparatus built for the investigation of these problems is described, and the results obtained are discussed. (auth)

23487 AN UNSTEADY PROBLEM IN MAGNETOHYDRODYNAMICS. Stephen Childress (California Inst. of Tech., Pasadena). Quart. Appl. Math., 21: 76-8(Apr. 1963).

A solution of the boundary value problem for an infinite mass of incompressible, electrically conducting fluid that is penetrated by a uniform magnetic field and subjected to disturbances by a vertical flat plane executing simple harmonic oscillation is presented. (C.E.S.)

23488 DETERMINATION OF CRITICAL THERMAL FLUXES IN TUBES OF HIGH-BOILING COOLANT. L. S. Sterman and V. D. Mikhailov (Inst. of Power Engineering, Moscow). Teploenerg., No. 2, 82-7(Feb. 1963). (In Russian)

Critical heat flux values for monoisopropyl diphenyl boiling in pipes at 3, 5, and 7 atm of pressure, 4 to 8 m/sec flow rate, and 0 to 170°C ranged from 1.5×10^6 to 4.5×10^6 kcal/m^2 · hour. The data showed that the universal formulas are not sufficient for determining the heat flux of boiling organic fluid. (R.V.J.)

23489 EFFECTS OF CHANNEL GEOMETRY ON THE CRITICAL HEAT LOAD IN FORCED WATER FLOW. B. A. Zenkevich, O. V. Remizov, and V. I. Subbotin. Teploenerg., No. 7, 81-3(July 1962). (In Russian)

The $q_{crit.}$ for forced flow in triangular and rectangular pipes with rounded corners was found, and the results were compared with flow in round pipes. The obtained data are applied to reactor conditions. (R.V.J.)

23490 MAGNETO-HYDRODYNAMIC CHANNEL FLOW AS INFLUENCED BY WALL CONDUCTANCE. Chieh-Chien Chang (Univ. of Minnesota, Minneapolis) and James T. Yen. Z. Angew. Math. Phys., 13: 266-72(1962). (In English)

A solution is presented for incompressible viscous fluid channel flow with uniformly applied transverse magnetic field, taking into account electrical conductance effects of the upper and lower channel walls. Conclusions concerning the velocity profiles and the electric current distribution within the fluid are discussed. (C.E.S.)

23491 PROCEEDINGS OF THE 1963 HEAT TRANSFER AND FLUID MECHANICS INSTITUTE HELD AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CALIFORNIA, JUNE 12, 13, 14, 1963. Anatol Roshko, Bradford Sturtevant, and D. R. Bartz, eds. Stanford, Calif., Stanford University Press, 1963. 296p. $8.75.

Eighteen papers are presented on heat transfer, fluid mechanics, and related fields. Separate abstracts were prepared for four papers which treat high-temperature argon, vapor condensation on rotating cylinder, bubble growth in boiling, and forced convection of helium and hydrogen. (D.L.C.)

23492 HEAT TRANSFER FROM HIGH TEMPERATURE ARGON. M. Camac, J. A. Fay, R. M. Feinberg, and N. H. Kemp (Avco-Everett Research Lab., Everett, Mass.). p.58-76 of "Proceedings of the 1963 Heat Transfer and Fluid Mechanics Institute." Stanford, Calif., Stanford University Press, 1963.

A report is given of an experimental and theoretical study of the interaction of high temperature argon with the end wall of a shock tube. Measurements of the heat transfer to the end wall were performed using a new type of infrared heat transfer gage that operates in the presence of a highly ionized plasma. The nonsteady nature of the flow and the fast response of the gage made it possible to measure the convective heating before radiative heating became important. A theoretical study of the ionization processes and the flow near the end wall led to the estimates that the measurements were made first in atomic argon up to 65,000°K and then in argon in ionization equilibrium up to 45% ionized. Boundary layer heat transfer calculations were made for these two cases and compared with the measurements. For atomic argon, experiment and theory are in remarkable agreement, providing experimental confirmation of the assumed dependence of thermal conductivity k on temperature, $k \propto T^{1/2}$, up to 65,000°K. For ionization equilibrium, the theory falls 20% to 30% below the experiments, which is probably within the accuracy of the theory and experiments. (auth)

23493 THE CONDENSATION OF VAPOR ON A HORIZONTAL ROTATING CYLINDER. Ralph M. Singer (Argonne National Lab., Ill.) and George W. Preckshot. p.205-21 of "Proceedings of the 1963 Heat Transfer and Fluid

Mechanics Institute." Stanford, Calif., Stanford University Press, 1963.

Heat transfer measurements are made for a vapor condensing on the outer surface of a horizontal, one inch diameter, rotating cylinder. Three distinct heat transfer and/or hydrodynamic regimes were observed: a laminar, gravitational flow of the condensate at low rotational speeds, with decreasing heat transfer coefficients with increasing speed; an unstable, film-like condensation at moderate speeds, with increasing coefficients with increasing speeds due to thinning of the condensate film by centrifugal force; and a region with decreasing transfer coefficients with increasing speed for very high speeds. Models were proposed for the first two regimes and show reasonable agreement with the experimental results. The data were successfully correlated for the non-laminar regimes by a plot of $NU)gD_0^3\rho h_{fg}/\nu k\Delta T)^{-1/4}$ versus the Weber number, We. (auth)

23494 THE GROWTH AND COLLAPSE OF VAPOR BUBBLES ON A BOILING SURFACE. D. E. Dougherty and H. H. Rubin (Knolls Atomic Power Lab., Schenectady, N. Y.). p.222-35 of "Proceedings of the 1963 Heat Transfer and Fluid Mechanics Institute." Stanford, Calif., Stanford University Press, 1963.

Several authors, notably Plesset, Zwick, and Zuber have treated the asymptotic growth and collapse of a vapor bubble during subcooled boiling by considering the growth and collapse process separately. Using energy considerations and retaining the basic assumptions of the Plesset and Zwick vapor bubble model, an integral equation was obtained for the trajectory of the liquid-vapor interface during the growth and collapse of a vapor bubble. A simple relationship for both the asymptotic growth and collapse was obtained from this integral equation by noting the existence of a stationary point at the time of collapse, and using the calculus of variations to determine the growth-collapse trajectory. It was found that the normalized asymptotic bubble trajectory may be expressed independent of the temperature distribution in the superheated liquid phase surrounding the vapor bubble. The asymmetry ratio, i.e., the ratio of the time to reach the maximum bubble radius t_m, and the total bubble lifetime t_c, is sufficient to define the normalized bubble radius. These analytic results compared favorably with a sampling of Ellion's experimental data. The analysis also gives a relationship between the asymmetry ratio and the initial growth period t_0, where surface tension effects are important. This dwell period therefore affects the skewness of the asymptotic bubble trajectory. The normalized bubble radius, the velocity and acceleration of the vapor-liquid interface, and the vapor temperature and pressure were obtained for a bubble with an asymmetry ratio of $\frac{1}{2}$. The pressure and temperature of the vapor phase drop very rapidly toward saturation, indicating why reasonably good results were obtained for the growth trajectory using a conduction model and assuming a saturated vapor phase. The pressure and temperature reach a minimum shortly before the bubble reaches its maximum size. As is to be expected, the pressure and temperature increase during the collapse stage. A reasonably sophisticated conduction model was retained in the analysis by noting that the energy transfer into the vapor phase can be described by the first zonal harmonic of the conduction equation, and thus, it was unnecessary to solve for the complete temperature field in the liquid phase. (auth)

23495 LOCAL HEAT-TRANSFER MEASUREMENTS FOR FORCED CONVECTION OF HYDROGEN AND HELIUM AT SURFACE TEMPERATURES UP TO 5600°R. Maynard F. Taylor (National Aeronautics and Space Administration, Cleveland). p.251-71 of "Proceedings of the 1963 Heat Transfer and Fluid Mechanics Institute." Stanford, Calif., Stanford University Press, 1963.

Local values of heat-transfer coefficients and average friction coefficients were measured experimentally for helium and hydrogen gas flowing through an electrically heated tungsten tube with a length-diameter ratio of 77 for the following range of conditions: local surface temperatures up to 5600° R, local Reynolds number from 7600 to 39,500, local ratios of surface-to-bulk gas temperature up 5.6, and heat flux up to 1,700,000 Btu per hour per square foot. A comparison of local heat-transfer coefficients for helium and hydrogen gas is made for several types of wall temperature distribution, which determines whether the data can be correlated by a Dittus-Boelter type equation. A wall temperature distribution for hydrogen is compared with one for helium and found to be essentially the same; this result demonstrates that any dissociation of hydrogen at the tube wall for wall temperatures up to 5200° R has little or no effect on the wall temperature distribution. (auth)

Materials Testing

Refer also to abstract 23591.

23496 (EURAEC-652) DEVELOPMENT OF NONDESTRUCTIVE TESTING INSTRUMENTATION FOR REACTOR PRESSURE VESSELS. Quarterly Report No. 1. February 1, 1963–April 1, 1963. Warren J. McGonnagle (Southwest Research Inst., San Antonio). Apr. 19, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1243. 26p.

A nondestructive testing technique is being developed for measuring the shift in the nil ductility transition temperature of A-212 Grade G steel. The experimental program is divided into three phases, as follows: establishment of experimental feasibility, determination of reliability of nondestructive test methods, and application of best methods. The first phase of the program is directed toward stimulating the shift in nil ductility transition temperature resulting from metallurgical mechanisms rather than radiation effects. The first technique employed was cold rolling which produced significant changes in the transition temperature with no obvious grain growth. Ultrasonic techniques for determining residual stress and attenuation in the cold rolled specimen are being investigated. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstract 23561.

23497 (D1-82-0241) TRAPPED RADIATION AND IONOSPHERIC PERTURBATIONS DUE TO AN IMPULSIVE NEUTRON SOURCE. James F. Kenney and H. R. Willard (Boeing Scientific Research Labs., Seattle). Apr. 1963. 86p. (AD-403020)

Computations based on the neutron decay model postulated by Crain and Tamarkin were carried out to evaluate the contribution of the decay products of neutrons emitted from a fission reaction to associated ionospheric disturbances and trapped radiation increases. It is shown that the fission neutron source is useful in explaining the morphology of nuclear-associated VLF effects although the amount of ionization produced promptly in the D-region may be insufficient to account for the magnitude of these effects. Experimental evidence is also advanced to show the detection of short-lived trapped radiation from this neutron decay source. The contribution to the long-lived trapped radiation is shown to be negligible. Neutron deposition densities for various burst latitudes and times are given. (auth)

23498 (GCA-TR-63-3-G) FINAL REPORT OF RESEARCH AND DEVELOPMENT IN THE STUDY OF TECHNIQUES FOR DETERMINING THE DISTRIBUTION OF RADIOACTIVE MATERIAL DEPOSITED IN THE UPPER ATMOSPHERE. Owen Cote, Edward Manring, and George Ohring (Geophysics Corp. of America, Bedford, Mass.). Apr. 1963. Contract AT(30-1)-2908. 89p. (NYO-10396)

Available information on circulation processes in the upper atmosphere (above 30 km) including mean motions, seasonal and latitudinal variations, synoptic variations, and periodic oscillations is summarized. The bearing of this information on the transport and spread of contaminants released into the upper atmosphere is discussed. Available information on eddy diffusion coefficients and residence times for the upper atmosphere is reviewed. Two theoretical models for predicting the rate of spread of a contaminant released into the upper atmosphere were developed and used in calculations of vertical transport times. The first model, which considers the effects of gravity and molecular diffusion on the vertical spread of molecular contaminants, appears to be useful for the region above 100 km. The second model, which attempts to consider the effect of turbulent diffusion in the atmosphere below 100 km, is probably a gross oversimplification of actual mixing processes. An experiment is suggested for observational determination of atmospheric diffusivity up to 30 km altitude. (auth)

23499 (NP-12773) TRANSMISSION BY THE EARTH'S ATMOSPHERE OF THERMAL ENERGY FROM NUCLEAR DETONATIONS ABOVE 50-KM ALTITUDE. Thomas O. Passell (Stanford Research Inst., Menlo Park, Calif.). Apr. 30, 1963. Contract OCD-OS-62-135. 64p.

The extensive literature on transmission of solar energy by the earth's atmosphere supports transmission estimates for the average clear day at sea level ranging from around 80% for vertical rays to around 15% for rays 5° above horizontal. Cloud transmission (on the basis of 100% for a clear day) varies from around 30% for light cloud to around 3% for a dense cloud. Transmission factors can be computed when the more important atmospheric parameters are known, namely, thickness, liquid content, and droplet size of clouds; size and volume concentration of solid haze particles; and the reflectivity of the earth's surface. Theoretically estimated upper limits to the unattenuated energy flux from a 1000-Megaton detonation (taken from a companion study to the present one), combined with the above estimates of atmospheric transmission give ignition radii ranging from 250 km at 50-km burst height to 0 km at 240-km burst height for the average clear day at sea level. A conscious attempt has been made in this study to give upper limits to both transmission factors and energy fluxes. Thus, in real world situations, the ground effects are expected to be substantially less extensive and less intensive than these estimates would indicate. 15 references and abstracts for 40 papers and reports on attenuation of thermal radiation by the earth's atmosphere are included. (auth)

23500 (UCRL-6889) FRACTURE SYSTEMS INDUCED IN A DECOUPLED SHOT CAVITY. D. D. Young, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). June 8, 1962. Contract W-7405-eng-48. 81p.

The 1959–1960 high-explosive shot series in the Cary Salt Mine at Winnfield, Louisiana, utilized a 12- and a 30-foot-diameter sphere to evaluate the "Latter-hole" energy decoupling theory. A total of four shots ranging from 20 to 2000 pounds were fired in the 12-foot-diameter sphere. Project Winnow was a program designed to excavate and map the shot-induced fractures in the 12-foot sphere. The general fracture pattern found was random in nature, and the presence of a few strong extensive fractures was found to be under the control of man-made discontinuities in the salt. (auth)

23501 IMPORTANCE OF THE SHIELDING EFFECT IN THE STUDY OF NATURAL RADIOACTIVE MINERALS BY γ SPECTROMETRY. Georges L. A. Durand (Centre de Recherches Radiogeologiques, Nancy). Compt. Rend., 256: 2212-4(Mar. 4, 1963). (In French)

Results obtained by γ spectrometry in equilibrium studies are affected by the presence of heavy metals in the samples. It is necessary to take account of the shielding effect of these metals in the determination of the concentration of radioactive elements by γ spectrometry and in equilibrium studies of the uranium family. The knowledge of this state is often necessary in the interpretation of age measurements by the lead isotope method. (tr-auth)

23502 FRACTIONATION OF SULFUR ISOTOPES IN THE BLACK SEA AND ITS HISTORY. A. P. Vinogradov (Moscow Univ.). J. Chim. Phys., 60: 307-17(Jan.-Feb. 1963). (In French)

A biological reduction of sulfates is made in the water and muds of the Black Sea. The fractionation of sulfur isotopes in this process was studied. The most extensive range of fractionation of sulfur isotopes occurred during the formation of different forms (dipyrite, troilite, organic sulfur, and free sulfur), as a consequence of the reduction of sulfates in a maritime basin in the absence of ventilation by dissolved oxygen. The smallest fractionation effect was observed when the basin is composed of fresh water with ventilation by air. On these bases, it was shown that ~8000 years ago, the North Sea was a basin of fresh water. (tr-auth)

23503 THE UTILIZATION OF DEUTERIUM CONCENTRATION MEASUREMENTS FOR THE STUDY OF METEOROLOGICAL AND GEOLOGICAL PHENOMENA. Étienne

Roth (CEN, Saclay, France). J. Chim. Phys., 60: 339-50 (Jan.-Feb. 1963). (In French)

For some years, measurements of the deuterium concentration of water in all its forms (liquid, vapor, ice, hail, and snow) have become sufficiently precise and rapid so that series of systematic measurements could be undertaken. The relative and absolute precision attainable in these determinations and the order of magnitude of fractionations occurring during physicochemical transformations of water in its natural cycle are reviewed. An attempt at classification is made of the results of deuterium composition measurements and of results from the simultaneous or separate study of tritium and O^{18} concentrations. The problems dealt with to date are reviewed, and the results are discussed. In particular, determinations of the temperature and quantity of precipitations in Antarctica, age determinations of ices, and study of the formation of hail are emphasized. (tr-auth)

23504 THE ENHANCEMENT OF THE EQUATORIAL ELECTROJET DURING POLAR MAGNETIC SUBSTORMS. Syun-Ichi Akasofu (Univ. of Alaska, College) and Sydney Chapman. J. Geophys. Res., 68: 2375-82(May 1, 1963).

It is shown that the growth of auroral electrojets can greatly enhance the equatorial electrojet. This indicates that a part of the return current, spreading from the auroral zone to the ionosphere in low and middle latitudes, can extend to as far as the late afternoon side along the magnetic equator. The current systems inferred so far for polar magnetic substorms may have to be revised to include such an intense return current. The enhancement is used to infer the distribution of the highly conductive region along the magnetic equator. It is shown that the conductivity is about 4 to 7 times higher there than in middle latitudes. (auth)

23505 SOME COMMENTS ON DYNAMO THEORY. J. P. Dougherty (Cambridge Univ., Eng.). J. Geophys. Res., 68: 2383-4(May 1, 1963).

The possibility that electrical linkage, through the exosphere, between magnetically conjugate points, may influence the dynamo currents is considered. A very rough estimate suggests that the effect is worthy of quantitative study. (auth)

23506 RECENT MAGNETIC OBSERVATIONS IN THE PHILIPPINES. F. N. Glover (Manila Observatory). J. Geophys. Res., 68: 2385-94(May 1, 1963).

Two magnetic variometers were continuously operated at comparable longitudes at Baguio and Cebu, Philippines, 900 and 300 km north of the magnetic equator, respectively. An attempt was made to separate the electrojet contributions to the monthly mean of the daily range in H and Z. The jet appears to change its form with the season. The overhead disturbance currents appear north of Cebu at night, but south of Cebu during the day. Micropulsations, of peak-to-peak amplitude of 1 γ or greater, have a nonzero occurrence probability at any hour, with a maximum at local noon and a secondary maximum about midnight. The Johnston Island July 9, 1962, disturbance effects on the Philippine magnetic traces are presented. (auth)

23507 THE DISTURBANCE DAILY VARIATION OF THE EARTH'S FIELD NEAR THE MAGNETIC EQUATOR. Rosemary Hutton (Univ. of Ghana, Legon). J. Geophys. Res., 68: 2395-2402(May 1, 1963).

The S_D variations of the horizontal and vertical magnetic elements of the earth's magnetic field at nine mid and low-latitude stations and of the earth-current components at Legon, Ghana, are presented and discussed. For stations in the region of the equatorial electrojet in Africa, the S_D variations differ considerably from those at midlatitudes. The difference between the equatorial S_D and the midlatitude S_D is found to consist of variations with a midday maximum in H and a midday minimum in Z. This finding suggests that there is either an additional S_D current near the magnetic equator or an increase in the strength and width of the equatorial electrojet during magnetic disturbance. Also the earth-current S_D variation is found to agree reasonably well with the derivative of the S_D variation of the total field F. (auth)

23508 THE S VARIATION OF EARTH CURRENTS NEAR THE MAGNETIC EQUATOR, ITS SEASONAL CHANGES, AND ITS RELATION TO VARIATIONS OF THE MAGNETIC FIELD. Rosemary Hutton (Univ. of Ghana, Legon). J. Geophys. Res., 68: 2403-10(May 1, 1963).

The harmonic coefficients of the earth-current variations at two stations in Ghana are presented and discussed. The ratio of the two principal harmonics of the variations at Legon is found to exhibit a seasonal variation, which is interpreted as arising from a shift in the position of the electrojet axis. Chapman and Whitehead's expressions relating earth-current variations with variations of the magnetic field are discussed, with reference to corresponding relations deduced by Tikhonov and Lipskaya. (auth)

23509 A NEW LONGITUDE EFFECT IN THE GEOMAGNETIC SOLAR DAILY VARIATION. David G. Knapp and John W. Gettemy (Coast and Geodetic Survey, Washington, D. C.). J. Geophys. Res., 68: 2411-20(May 1, 1963).

The daily variation of geomagnetic vertical intensity (Z) at Koror, Palau Islands, slightly south of the dip equator, is characterized by a positive salient before 1100 hours and a negative one after 1500 hours. This feature, which persists throughout the year, appears to reflect a component of the Z curve that simulates the time derivative of the horizontal-intensity (H) curve. A similar though less pronounced effect may be discerned at Huancayo and at Trivandrum; at Addis Ababa its sign is reversed. This component probably makes inapplicable to Koror (and possibly to some other localities) the suggestion that the day-to-day fluctuations in the ratio of Z and H ranges in western Africa may reflect shifts in the latitude of the electrojet. To account for the observed Z effect it is suggested that there is superimposed on the conventional S_q pattern of ionospheric currents a north-south flow of current confined to the daylight side of the earth, that this current reverses its sign in a systematic relation with the earth's rotation, and that it may tend to channelize along the paths established by the S_q patterns, so as to become manifest in the daily-variation curves at stations in higher latitudes as well as along the dip equator. On the basis of the relative amplitudes of the eastward and westward salients of magnetic declination curves, the suggestion is strongly supported as regards Europe and the western hemisphere; but equivocal results are obtained for Australasia and the western Pacific, notwithstanding that Koror in this region exhibits the Z effect more strongly than any other equatorial station. Neither the source of the postulated current nor the path by which its circuit is completed is clear. It is conjectured that a persistent leakage of charged particles trapped in the magnetosphere, falling from their mirror points into the upper air, may give rise to vacillating potential differences between the northern and southern auroral zones, and that the phenomena here reported represent the ebb and flow of ionospheric current required to equalize these potential differences. (auth)

23510 RECENT MEASUREMENTS OF THE MAGNETIC FIELD OF THE EQUATORIAL ELECTROJET IN NIGERIA. P. O. Ogbuehi and Agodi Onwumechilli (Univ. of Ibadan, Nigeria). J. Geophys., Res., 68: 2421-4(May 1, 1963).

Photographic records of the daily variations of the magnetic elements H, D, and Z were taken at 10 stations across the magnetic zero dip equator in Nigeria around the June solstice (May to July) 1962. A preliminary analysis of these records locates the axis of the equatorial electrojet on the magnetic equator (10.2°N latitude in Nigeria), and there the average daily range of Z was practically zero. On the model of a uniform current band at a height of 110 km the equatorial electrojet in this season was found to have a width of (406 ± 20) km and a current intensity of 116 amp km^{-1}. These values are compared with other existing values; they show clearly that both the width and the intensity of the electrojet have decreased with decrease in solar activity. (auth)

23511 SEPARATION OF THE SEMIDIURNAL TIDAL EFFECT ON INDIVIDUAL DAYS AND SOME EQUATORIAL FEATURES OF THE GEOMAGNETIC LUNAR TIDE. Agodi Onwumechilli (Univ. of Ibadan, Nigeria). J. Geophys. Res., 68: 2425-33(May 1, 1963).

A method of estimating the lunar effect (L) on individual days is reported. Calculations are carried out to demonstrate how it may help in the study of some aspects of the L field. The contribution of the L field to the diurnal variation of the geomagnetic horizontal field (H) at Ibadan is found to be large, but it is not clear whether big-L days of the type reported by Bartels and Johnston really exist. The evidence is such that, if the existence of big-L days is accepted, the existence of small-L days and even inverse-L days has to be accepted. The results rather indicate that the magnification of L may vary from hour to hour on the same day. The asymmetry in the variation of H near the magnetic equator is found not to arise from the L field. (auth)

23512 DAILY VARIABILITY IN STRENGTH OF THE EQUATORIAL ELECTROJET. D. G. Osborne (Univ. of Ghana, Legon). J. Geophys. Res., 68: 2435-9(May 1,1963).

Values are deduced for the contributions to the diurnal range of the horizontal magnetic component by the normal S_q current system and the equatorial electrojet. Both contributions vary much from day to day, but there is only a weak correlation between the two. Hence it is suggested that in analyzing magnetograms ranges should not be normalized by taking ratios for different stations near the magnetic equator. It is also argued that the electrojet cannot be a simple enhancement of the normal current in a belt of high conductivity. Evidence is given for a slight decrease in electrojet strength on magnetically disturbed days. (auth)

23513 EQUATORIAL DRIFT AND THE ELECTROJET. D. G. Osborne (Univ. of Ghana, Legon) and N. J. Skinner. J. Geophys. Res., 68: 2441-4(May 1, 1963).

Apparent horizontal east-west drift velocities in the F layer were measured near the magnetic equator at Tamale in northern Ghana by the spaced-receiver, pulse-fading method. These velocities are compared with changes in the horizontal magnetic field strength in the daytime. It is shown that the drift velocity is closely related to the current strength in the equatorial electrojet and that it increases when the jet current increases. (auth)

23514 LUNAR TIDAL VARIATIONS IN THE EQUATORIAL ELECTROJET CURRENT. R. G. Rastogi (Physical Research Lab., Ahmedabad, India). J. Geophys. Res., 68: 2445-51(May 1, 1963).

The lunar semidiurnal variations in the solar diurnal range of the horizontal component of the earth's magnetic field H are computed for the equatorial stations that were operating in Peru during the IGY and IGC. The amplitude is found to be greatly enhanced on either side of the magnetic equator within magnetic dip of about ±10°. The narrow regions of enhanced lunar tidal effect and solar diurnal variation in H are similar to each other, suggesting that lunar semidiurnal tides affect the same region as that containing the well-known solar diurnal equatorial electrojet. The lunar effects in South America are found to be maximum during the southern solstice at stations within the zone of the equatorial electrojet, but during the equinoxes at stations in middle latitudes. (auth)

23515 SOME ASPECTS OF E_s IONIZATION OF THE MAGNETIC EQUATORIAL REGION. P. Bandyopadhyay and H. Montes (Instituto Geofisico del Peru, Huancayo). J. Geophys. Res., 68: 2453-84(May 1, 1963).

An examination of diurnal and seasonal variation of the occurrences of three different types of sporadic ionization E, namely, equatorial, low, and flat types, at the South American transequatorial chain of stations is discussed. Lunar influences and some correlation with geomagnetic disturbances on the occurrences are also discussed. The Huancayo ionograms are examined in some detail to study closely the equatorial E_s, particularly its sudden disappearances. The Huancayo magnetograms are also examined to associate some of the observed characteristics of E_s with certain distinctive features of the magnetograms. (auth)

23516 FIELD-ALIGNED E-REGION IRREGULARITIES IDENTIFIED WITH ACOUSTIC PLASMA WAVES. K. L. Bowles, B. B. Balsley, and Robert Cohen (Jicamarca Radar Observatory, Lima). J. Geophys. Res., 68: 2485-2501 (May 1, 1963).

Measurements related to the nature of field-aligned irregularities in the ionosphere E region are presented. The measurements were performed near the magnetic equator, and the irregularities are attributed to the equatorial electrojet. It is shown that the irregularities are most likely to consist of plane acoustic waves generated by an instability resulting from the flow of current in the electrojet. Reference is made to a recent theory in which the existence of such waves is predicted. The characteristics of auroral radar echoes are shown to be similar to those of the equatorial echoes. It is inferred that the auroral field-aligned irregularities are also caused by the flow of electrojets. (auth)

23517 EQUATORIAL IONOSPHERIC VARIATIONS DURING GEOMAGNETIC STORMS. S. Matsushita (High Altitude Observatory, Boulder, Colo.). J. Geophys. Res., 68: 2595-2601(May 1, 1963).

During geomagnetic storms, ionospheric short-time electron density variations in the magnetic equatorial zone and low latitudes seem to be characterized by an increase of the maximum electron density of the F_2 layer. This increase is confirmed by the electron density profile data. Possible causes of the increase are discussed. (auth)

23518 EFFECTS OF THE NUCLEAR EXPLOSION OVER JOHNSTON ISLAND OBSERVED IN PERU ON JULY 9, 1962. M. Casaverde and A. Giesecke (Instituto Geofisico del Peru, Lima) and Robert Cohen. J. Geophys. Res., 68: 2603-11(May 1, 1963).

An account is given of observations in Peru associated

with the nuclear explosion over Johnston Island on July 9, 1962. The observations discussed are principally those of magnetic micropulsation activity resulting from the electron loop frequency and hydromagnetic waves accompanying the explosion. (auth)

23519 GEOMAGNETIC FLUCTUATIONS WITH THE FREQUENCIES OF TORSIONAL OSCILLATIONS OF THE EARTH. D. E. Winch, B. A. Bolt, and L. Slaucitajs (Univ. of Sydney). J. Geophys. Res., 68: 2685-93(May 1, 1963).

Frequency analyses of magnetograms from Port Moresby Observatory have disclosed an apparently new feature of the geomagnetic field. After the great 1960 Chilean earthquake the local field contained low-energy harmonics with periods 43.1, 29.0, 22.4 min approximately, near those of the three gravest torsional oscillations of the earth, ${}_0T_2$, ${}_0T_3$, ${}_0T_4$. These harmonics were absent just before the earthquake. The methods of analysis, characteristics of the magnetograms, and possible mechanisms of generation are discussed briefly. (auth)

23520 RADIO NOISE ANOMALIES IN AUGUST 1958. C. A. Samson (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 68: 2719-26(May 1, 1963).

Comparison of radio noise data for August 1958 with those for later years shows that the Johnston Island nuclear explosions on August 1 and 12, 1958, affected the atmospheric radio noise over a wide area in the Pacific region. Graphs of the midnight noise level at several frequencies from 13 kc/s to 5 Mc/s illustrate apparent noise anomalies at Cook, Australia; Ohira, Japan; Byrd Station, Antarctica; and Singapore. These anomalies resemble in several respects the well-marked effects previously noted at Kekaha, Hawaii. (auth)

23521 CALCULATIONS OF THE BLAST AND CLOSE-IN ELASTIC RESPONSE OF THE CAVITY EXPLOSIONS IN THE COWBOY PROGRAM. H. L. Brode and B. R. Parkin (Rand Corp., Santa Monica, Calif.). J. Geophys. Res., 68: 2761-89(May 1, 1963).

Theoretical calculations of wall pressures and elastic wave radiations from high-explosive detonations in spherical cavities in salt are compared with close-in experimental results from the Cowboy program. Spherical charges of Pelletol ranging from 20 to 2000 pounds were detonated in spherical cavities 12 and 30 feet in diameter. The elastic wave and the wall-pressure results were found to be sensitive to the explosive detonation details. New ways are suggested for correlating such quantities as explosive and radiated energies, peak values of particle displacement, velocity, acceleration, and radial stress. This correlation procedure can be useful in scaling peak particle velocities from cavity or uncoupled explosions; it is demonstrated for the Cowboy results. (auth)

23522 A PRELIMINARY EVALUATION OF URANIUM SERIES INEQUILIBRIUM AS A TOOL FOR ABSOLUTE AGE MEASUREMENT ON MARINE CARBONATES. Wallace S. Broecker (Lamont Geological Observatory, Palisades, N. Y.). J. Geophys. Res., 68: 2817-34(May 1, 1963).

Experimentally determined ratios of Ra^{226} to U^{238} for marine carbonates are compared with ratios predicted on the basis of the age of the sample as determined by radiocarbon. The following assumptions are made in computing these ratios: the initial concentrations of Ra^{226} and Th^{230} are too small to make a significant contribution to the Ra^{226} currently in the sample, the U^{234} concentration is initially 15 per cent in excess of its equilibrium value, and the samples act as closed systems for U, Th, and Ra. Three major conclusions may be drawn: fossil mollusks contain appreciably more uranium than their contemporary equivalents, acid leach fractions have considerably higher Ra^{226}/U^{238} ratios than the residual material and, the Ra^{226}/U^{238} ratios are either within experimental error of, or in excess of, the predicted ratios. Measurements of Th^{230}, Th^{232}, U^{234}, and Pa^{231} are necessary before any elaborate interpretation of the observed anomalies is attempted. (auth)

23523 SULFUR ISOTOPE ABUNDANCES IN BASIC SILLS, DIFFERENTIATED GRANITES, AND METEORITES. M. Shima, W. H. Gross, and H. G. Thode (McMaster Univ., Hamilton, Ont.). J. Geophys. Res., 68: 2835-47 (May 1, 1963).

Studies were made of the S^{32}/S^{34} ratios in four large basic sills presumably of deep-seated origin. The average ratio for these sills was determined by weighting each sample according to sulfur content and in accordance with the thickness of rock represented by each sample. These average ratios were within 1.0 per mil of the value for meteoritic sulfur. This is comparable with a spread of about 12.0 per mil for igneous rocks and an over-all spread of about 120.0 per mil for terrestrial samples. In the study of igneous rocks, both intrusive and extrusive, a number of granitic intrusives were found to have S^{32}/S^{34} ratios completely outside the range of values for all other igneous rocks. The results suggest that these intruded granites are regenerated sediments rather than acidic differentiates that have risen from the subcrust or mantle. (auth)

23524 ISOTOPIC ABUNDANCE OF METEORITIC LITHIUM. Makoto Shima and Masatake Honda (Univ. of California, San Diego). J. Geophys. Res., 68: 2849-54 (May 1, 1963).

The abundances of Li^7 and Li^6 in stone meteorites were determined by mass-spectrometric techniques. The peak ratio of Li^7/Li^6 was observed as 10.5 in lithium samples isolated from three chondrites, Bruderheim, Harleton, and Ehole. Terrestrial rock samples showed a value of 12.0 under the same experimental conditions. Some possible mechanisms that might have resulted in the difference in ratio between the meteoritic and the terrestrial lithium are discussed. (auth)

23525 BEHAVIOR OF ZENITH [O I] 6300 A AIRGLOW AT TOWNSVILLE DURING HIGH-ALTITUDE NUCLEAR EXPLOSIONS. E. H. Carman, B. C. Gibson-Wilde, B. P. Kilfoyle, and W. M. Coleman (University Coll. of Townsville, Pimlico, Australia). J. Geophys. Res., 68: 2855-7 (May 1, 1963).

Diurnal zenith values of airglow during high-altitude nuclear explosions determined by means of a photometer fitted with an interference filter centered near 6300 Å are presented. The measurements were carried out at Townsville, Australia for explosions of July 9, October 20, October 26, November 1, and November 4, 1962. Large increases in intensity are evident, but results suggest that the enhancement was due to seasonal trends rather than the effects of nuclear explosions. (C.E.S.)

23526 A STUDY OF DIAGNOSTIC TECHNIQUES FOR IDENTIFYING EARTHQUAKES. Frank Press, Gilbert Dewart, and Ralph Gilman (California Inst. of Tech., Pasadena). J. Geophys. Res., 68: 2909-28(May 15, 1963).

Several diagnostic techniques are examined for identifying earthquakes as events distinct from possible underground nuclear explosions. It is found that the typical or mean earthquake differs in a statistically significant way from the mean explosion for most of the techniques. Be-

cause of the variability of earthquake signatures, many earthquake parameters fall within the range observed for explosions. The percentage of earthquakes that fall entirely outside the range observed for explosions for the particular techniques are discussed. Long-period surface waves are excited by most events of magnitude greater than 4.4. For $3.9 < M_L < 4.4$ only $\frac{1}{4}$ of the events generated surface waves. It is argued on theoretical grounds that the absolute value and not the shape of the spectra of surface waves depends on magnitude for earthquakes below a certain magnitude. If this were so, the prevailing periods of Rayleigh waves from small-magnitude explosions and earthquakes would not differ. (auth)

23527 MORATORIUM FALLOUT AND STRATOSPHERIC STORAGE. W. F. Libby (Univ. of California, Los Angeles). J. Geophys. Res., 68: 2933-7(May 15, 1963).

The data on radioactive fallout for the three-year period October 1958 to September 1961, during which no atmospheric nuclear tests were fired, were reviewed to check on the best value for the stratospheric residence time and the question of its over-all significance and usefulness as a concept. The general result — about five years for equatorial injections and a little less than one year for low-megaton polar tests — is in general keeping with the model suggested earlier. (auth)

23528 XENOLOGY. J. H. Reynolds (Univ. of California, Berkeley). J. Geophys. Res., 68: 2939-56(May 15, 1963).

Work in the field of xenon isotope abundances in meteorites is discussed in the context of current theories about the formation of the heavy elements and the early history of the solar system. Using a model in which the special (Xe^{129*}) anomaly is due to decay of I^{129} produced in the principal galactic synthesis, it is concluded that meteorites Abee and Richardton began to retain radiogenic xenon 52 million years after the cessation of nucleosynthesis. The xenon-retentive phase of the Bruderheim meteorite was formed 17 million years earlier, a result that depends very little on the model chosen for the origin of the I^{129}. An iron meteorite appears to have cooled about 200 million years later than Abee. The general anomalies in meteorites, including carbonaceous chondrites, are not fixed but vary with release temperature in a heating experiment, suggesting that components of different isotopic composition are being fractionated in the release of the gas. A search for fissionogenic xenon in meteorites has yielded very definite evidence of two components of xenon in some meteorites, especially convincing results being presented for chondrules from the Bjurböle meteorite. (auth)

23529 DISCORDANT URANIUM–LEAD AGES. 2. DISCORDANT AGES RESULTING FROM DIFFUSION OF LEAD AND URANIUM. G. W. Wetherill (Univ. of California, Los Angeles). J. Geophys. Res., 68: 2957-65(May 15, 1963).

The solution to the equation for the diffusion of lead and uranium from a sphere, including the effect of a pulse of metamorphism, is applied to the problem of discordant U–Pb ages. It is found that a pulse of metamorphism can greatly disturb the straight-line pattern found by Tilton, and the implications of this with regard to the thermal history of zircons are discussed. The effect of pure U diffusion is found to generate a straight-line pattern having a different slope from that for pure Pb diffusion. A very small amount of U diffusion combined with Pb diffusion can significantly alter Tilton's straight-line pattern. This effect is relatively insensitive to the magnitude of the U diffusion. The effects of combined U and Pb diffusion with a pulse of metamorphism are found to be too complex to exhibit regularities. (auth)

23530 RADIO-FREQUENCY BACKSCATTER OF ARTIFICIAL ELECTRON CLOUDS. Philip B. Gallagher (Stanford Univ., Calif.) and R. A. Barnes. J. Geophys. Res., 68: 2987-3010(May 15, 1963).

Backscatter and forward-scatter reflection properties of chemically created electron clouds were measured throughout the HF spectrum. The measurements included radar cross sections, signal fading characteristics, and frequency-time-dependence. These quantities led to certain conclusions regarding the cloud model that describes in general the chemical releases. The model so presented appears to be a limited coherent type of reflector; i.e., it is composed of an assembly of reflectors of coherent nature in a random motion that in turn give rise to a partially incoherent radar scatter signal. This simple model adequately describes most of the cesium releases, but it fails often enough to show that further experimentation is required. (auth)

23531 THE LIFETIME AND MOVEMENT OF ARTIFICIALLY PRODUCED ELECTRON CLOUDS OBSERVED WITH SPACED IONOSONDES. J. W. Wright (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 68: 3011-20(May 15, 1963).

Observations of electron clouds in the 1960 Firefly Series, made with four closely-spaced ionospheric sounders, are described. Movements of the clouds as deduced by these radio means correspond closely to those observed optically throughout the period when such observation was possible. Cloud lifetimes sometimes exceeded two hours under sunlit conditions but were much shorter in the absence of ionizing radiation. In either case, the cloud echoes resemble those from sporadic E, but the relationship between the two phenomena is puzzling. Evidence is given for a height-gradient of drift velocity in the altitude range 95 to 115 km. A correspondence is noted between the cloud drift velocity pattern and the wind system calculated from geomagnetic data by the dynamo theory of the S_q current system. (auth)

23532 HYDROMAGNETIC WAVES GENERATED BY THE JULY 9, 1962, NUCLEAR WEAPONS TEST AS OBSERVED AT COLLEGE, ALASKA. Charles R. Wilson (Univ. of Alaska, College) and Masahisa Sugiura. J. Geophys. Res., 68: 3149-53(May 15, 1963).

Magnetic effects of the July 9, 1962, high-altitude nuclear weapons test near Johnston Island are studied by means of the record obtained with a rubidium vapor magnetometer at College, Alaska, and the records taken by the U. S. Coast and Geodetic Survey at College and Sitka, Alaska. The first event recorded by the rubidium magnetometer was a sudden increase in the total field 2.1 sec after the detonation; this was followed by a large-amplitude oscillation of period 2.5 to 3 sec, which drove the recorder off scale for several cycles. The first impulse is interpreted as a predominantly longitudinal hydromagnetic wave generated by the detonation. The second event, which commenced 52 sec after the detonation, was recorded by the rubidium magnetometer as a 3 γ negative impulse lasting about 8 sec. The third phase of the bomb effect was a large-amplitude magnetic perturbation of much longer period than the first event, beginning 66 sec after the detonation. This event is interpreted as the arrival of a transverse hydromagnetic wave generated in the magnetosphere at several earth radii and transmitted along the lines of magnetic force to the earth; the transverse wave was generated in the magnetosphere by coupling

with the compressional hydromagnetic wave that propagated outward near the equatorial plane from the detonation point. (auth)

23533 MAGNETIC STORMS: THE SIMULTANEOUS DEVELOPMENT OF THE MAIN PHASE (DR) AND OF POLAR MAGNETIC SUBSTORMS (DP). S.-I Akasofu (Univ. of Alaska, College) and S. Chapman. J. Geophys. Res., 68: 3155-8(May 15, 1963).

The development during magnetic storms of the main phase (DR) and of polar magnetic substorms (DP) is examined by comparing several Honolulu H magnetograms (for the DR) and the values of the corresponding planetary ap index (for the DP). It is shown that the DR and DP fields develop simultaneously. However, the storm-time increase in the solar plasma pressure, sudden or continuous, does not seem to be related in any simple way to the increase of particle kinetic energy density of the ring current or of the auroral particles. (auth)

23534 GEOMAGNETIC CONTROL OF SATELLITE SCINTILLATIONS. J. Aarons (Air Force Cambridge Research Center, Bedford, Mass.), J. Mullen, and Sunanda Basu. J. Geophys. Res., 68: 3159-68(May 15, 1963).

Satellite scintillations may be divided into three basic types: low-angle scintillations of both tropospheric and ionospheric origin; clouds or patches of ionization containing irregularities including sporadic E; and precipitation scintillation occurring for the most part at heights of 300 to 500 km. The third type is discussed in detail; the hypothesis is advanced that this basic mechanism of auroral-zone scintillation originates in irregularities produced by precipitation of charged particles on the atmosphere, the precipitation boundary being controlled in the same manner as the aurora. The variation of scintillation index with angle of elevation is pronounced when looking north from the observatory (54°N geomagnetic) in comparison with that when looking south. During magnetic storms the irregularity structure moves to lower latitudes in much the same manner as other auroral phenomena. The use of satellite transmissions permits the separation of subionospheric geomagnetic latitudes from angles of elevation; this was not done in most studies of radio-star sources. (auth)

23535 THICKNESS OF ZENITHAL AURORAL ARC OVER FORT CHURCHILL, CANADA. J. S. Kim and R. A. Volkman (Univ. of Idaho, Moscow). J. Geophys. Res., 68: 3187-90(May 15, 1963).

The thicknesses of forty independent homogeneous auroral arcs that occurred directly above Fort Churchill during 1958 were measured. The measured values for the thickness were in the range 3.5 to 18.2 km; the average was 9.1 km. The thicknesses increase with geomagnetic activity. No significant daily or seasonal variation of thickness was found. (auth)

23536 ISOTOPIC VARIATIONS IN TERRESTRIAL XENON. W. A. Butler (Univ. of California, Berkeley), P. M. Jeffery, J. H. Reynolds, and G. J. Wasserburg. J. Geophys. Res., 68: 3283-91(May 15, 1963).

Isotopic composition and amounts of xenon extracted from eclogite, from old granite, and from CO_2-well gases were measured. The Xe content of Bavarian eclogite is close to that of the earth, and this Xe exhibits no isotope anomalies. Xenon from several old granite samples from the central Transvaal contains substantial amounts of fissionogenic Xe from spontaneous fission of U^{238}. Isotopic composition of this Xe is in agreement with values reported by Wetherill. The amount of fission Xe in samples from three related granites was very uniform, suggesting that U–Xe dating would be a valuable adjunct to K–Ar dating for old samples. Rough calculations of the U–Xe ages of these granites are in agreement with Rb–Sr ages obtained by Allsopp. Xenon from the CO_2-well gases contained a component from spontaneous fission. The He^4/Xe_F^{136} ratio for this gas is very close to that expected for gas evolved from rocks with a Th/U ratio of 3. In addition, there was a small component of excess Xe^{129}, i.e., $Xe^{129*}/Xe_F^{136} = 0.92 \pm 0.42$. Arguments are given to show that this residual Xe^{129} is not due to fast or slow neutron absorption in Te^{128}. The excess Xe^{129}, if real appears to be due to decay, soon after formation of the earth, of now extinct 17-m.y. I^{129}. The effect has far-reaching implications: it implies that the outgassing of the interior of the earth is not complete and that even the decay products of some short-lived activities were not homogenized; calculations based on an extremely simple model give a rough indication of the time interval by which the earth postdates the meteorites. It is clear that further experiments with well gases should be made to see whether the effect is reproducible. (auth)

23537 LEAKAGE OF RADIOGENIC ARGON AND STRONTIUM FROM MINERALS IN PROTEROZOIC DOLERITES FROM BRITISH GUIANA. I. McDougall (Australian National Univ., Canberra), W. Compston, and D. D. Hawkes. Nature, 198: 564-7(May 11, 1963).

Age measurements are reported on 6 specimens of dolerite from British Guiana. The measurements were made by the K-Ar and Rb-Sr isotopic methods. The data indicate that the Lower Kopinang and Kamarang sills in northern South America are at least 2,090 million years old. (C.H.)

23538 PHOTOMETRIC OBSERVATIONS OF THE AURORA OF OCTOBER 28, 1961, AT SACRAMENTO PEAK, NEW MEXICO. S. M. Silverman (Air Force Cambridge Research Labs., Bedford, Mass.). Nature, 198: 677-9(May 18, 1963).

Observations are reported on the green (5577 Å) and red (6300 Å) line intensities of the aurora during the night of Oct. 28, 1961, in the time range of 0300 to 1200 UT. The results are compared with observations made in New Zealand on the same night. The northern enhancement of the red line corresponds in time to the appearance of visual aurora in both hemispheres. There is a time difference of ~1 hr between the green-line enhancements in the northern and southern hemispheres. The green-line enhancement is less than that of the red line. (D.L.C.)

23539 EARTHQUAKE OR EXPLOSION? H. I. S. Thirlaway (United Kingdom Atomic Energy Authority, Blacknest, Eng.). New Scientist, 18: 311-15(May 9, 1963).

Refinements to seismological instrumentation and the application of new processing techniques to well-known principles are outlined. Particularly, principles involved in the detection of small disturbances, the identification of earthquakes from other disruptions, and the estimation of the depth of events are reviewed. Seismic records of some explosions and earthquakes are discussed, and the future and usefulness of seismological arrays are examined. (D.C.W.)

23540 THE DISCHARGE THEORY OF THE NIGHT-GLOW EMISSION [OI] λ5577. A. Omholt [Universitetet, Oslo). Phys. Norvegica, 1: 33-40(1962). (In English)

The possibility that the emission of the green [OI] line in the night glow is due to a discharge mechanism in the ionosphere is examined. It is concluded that the electric field strength required for this process to be efficient is unacceptably high (more than 10^{-2} v/cm). An integro-

differential equation giving the energy distribution of the electrons in a model discharge is developed. (auth)

23541 SUNRISE AND SUNSET EFFECTS ON COSMIC NOISE ABSORPTION ASSOCIATED WITH AURORA AND MAGNETIC STORMS. Bengt Hultqvist (Kiruna Geophysical Observatory, Sweden). Planetary Space Sci., 11: 371-83(Apr. 1963).

The riometer recordings taken at Kiruna during the period September 1958 through 1961 were investigated with respect to the variation of auroral-type absorption during twilight periods. The average A_D/A_N ratio, i.e., that between post- and pre-twilight absorption at sunrise, and between pre- and post-twilight values at sunset, over the entire period was found to be 1.1 to 1.2. This is much lower than that which could be expected on the basis of the most recently proposed height distributions of the λ ratio of the negative ion density to the electron density. It is concluded that the contradiction would be eliminated if the λ distributions decreased so that even at night λ would reach unity at an altitude of about 60 km. (auth)

HEALTH AND SAFETY

Refer also to abstracts 23739 and 24633.

23542 (AD-286432) STERILIZATION OF SEWAGE CONTAINING PATHOGENIC MICROORGANISMS. NUCLEAR REACTOR. Phase I, Revised. Addendum to Report No. 9. (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 5, 1956. Contract DA-18-064-404-93. 29p.

The use of radiation and heat from a reactor for sterilization of sewage is discussed. Proposed methods, operational aspects, and calculations are outlined. It was concluded that an enriched-fuel reactor should be used, with an upper limit for the power level set at 300 Mw. Calculations showed no resulting activations of the sewage above tolerance. It was assumed that the sewage will act as a secondary coolant external to the reactor core. Economic aspects are discussed. (auth)

23543 (AEEW-R-215) THE A.E.E. WINFRITH WHOLE BODY MONITOR. C. O. Peabody, V. M. Fraser, and R. G. Speight (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1962. 41p.

The function, design, and construction of the A.E.E. Winfrith Whole-Body Monitor are described. The main purpose of the monitor is to measure gamma-emitting radioisotopes in the human body. Its performance, capabilities, and limitations are discussed, and a summary is given of experience gained and results obtained during the first few months of operation. The future program of measurements and development is outlined. Some basic design criteria are put forward as a result of the experience and results obtained. (auth)

23544 (DPSPU-63-30-1) HEALTH PHYSICS UTILIZATION OF AN IBM 1620 COMPUTER. J. R. Watts (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). May 1963. Contract AT(07-2-)1. 6p.

Many routine health physics functions are performed, and more complicated special problems are evaluated, by an IBM 1620 computer. Automation of radioactive assay techniques improves the utilization of employees and the quality and quantity of data. Particular uses of the computer are discussed, and advantages of using it are pointed out. (auth)

23545 (HW-64888) PLUTONIUM RECLAMATION FACILITY—HUMAN ENGINEERING CONSIDERATIONS FOR GLOVE BOX DESIGN. C. M. Thomas (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 26, 1960. Contract AT(45-1)-1350. 13p.

To assist in scoping alternates in the design of the Plutonium Reclamation Facility for feasibility, dimensional relationships, and cost estimates, a human engineering study was undertaken. This study was to define the limitations of an individual working through glove ports in a hood adapted to the specific requirements of the new facility. Equipment could then be designed compatible with these known area limitations, minimizing the accessibility problem. Fundamental motion patterns and limitations for an "average operator group" were developed for the specific criteria of the proposed facility. The envelopes generated by those basic patterns were then arranged to determine the best glove port relationship while adhering to the established criteria. Minimum eye ports were then developed which coincide with the recommended glove port pattern. In general, a vertical plane 18 in. from the glove port face, with a hood inside height of 49 in., is the recommended maximum accessible area compatible with the established criteria. Equipment necessitating contact should be concentrated at glove port center line height (56 in. to floor or step) and directly across from an eye port at approximately 10 to 12 in. Glove port horizontal spacing is recommended at 16 in. on center, using a right/left glove concept. Maximum areas indicated are for direct line access; restrictions which force the hands to detour around equipment will reduce the limits accordingly. (auth)

23546 (HW-77690) METHODS USED TO ESTABLISH PERMISSIBLE CONCENTRATIONS OF RADIOISOTOPES IN FRESH AND SEA WATER. R. F. Foster (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 24, 1963. Contract AT(45-1)-1350. 17p.

Methods used in calculating the maximum permissible concentrations of radioisotopes in fresh and sea water are based on the radiation dose to people using the water or eating fish from the water. Methods used at major AEC sites, Windscale, and other sites are discussed. (C.H.)

23547 (HW-SA-3022) BERYLLIUM CONTROL PROGRAM IN THE N-REACTOR FUELS OPERATION. B. R. Black (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 18, 1963. Contract AT(45-1)-1350. 10p.

The controls necessary to protect personnel from beryllium in the preparation of NPR fuel elements of uranium metal clad with Zircaloy and an alloy of Zircaloy and beryllium are described. All equipment where airborne beryllium might be generated is connected to the beryllium exhaust system, which consists of a primary filter at each of the stations where exhaust is provided and a central absolute filter. The absolute filter is designed to remove more than 99.9% of the beryllium in the air passing through it. Beryllium zones are established and all personnel who enter these zones must be medically cleared for work with beryllium. Protective clothing is worn in the beryllium zones. Waste disposal is regulated. (M.C.G.)

23548 (KY-400) UNION CARBIDE NUCLEAR COMPANY RADIATION STANDARDS AND PRACTICES. Recommendations of the Committee on Radiation and Standards and Practices. R. W. Levin, comp. (Paducah Gaseous Diffusion Plant, Ky.). Nov. 1962. Contract W-7405-eng-26. 10p.

Radiation practices among the 4 Carbide Plants at Oak Ridge, Tennessee, and Paducah, Kentucky, were evaluated, and uniform standards and criteria for handling U, Th, Np, and Pu were developed. Values for the permissible limits of internal and external radiation exposure published in the most current NCRP handbooks and FRC publications were adopted as the basic standards for all 4 plants. On the basis of these standards, the maximum permissible concentrations of U, Th, Np, and Pu in air and action limits for the presence of the 4 isotopes in urine were also established. Also, consideration was given to whether clothing should be furnished by the company for health protection purposes and whether surface contamination standards should be established. (P.C.H.)

23549 (ORNL-332) HEALTH PHYSICS INSTRUMENT MANUAL. D. M. Davis and E. D. Gupton (Oak Ridge Na-

tional Lab., Tenn.). May 16, 1963. Contract W-7405-eng-26. 141p.

The Health Physics Instrument Manual provides apprentice health physics surveyors and other operating groups not directly concerned with radiation detection instruments a working knowledge of the radiation detection and measuring instruments in use at ORNL. The manual contains a ready reference to the radiation-monitoring instruments and their characteristics, calibration and operation procedures of devices and sources, and a complete discussion of the ORNL badge dosimeter and its application to personnel monitoring. (N.W.R.)

23550 (ORNL-TM-555) EVALUATION OF THE EFFECTIVENESS OF BUILDING 3508 ALPHA AIR MONITORING. R. E. Leuze (Oak Ridge National Lab., Tenn.). Apr. 15, 1963. Contract W-7405-eng-26. 12p.

The effectiveness of the alpha air monitoring system in ORNL building 3508 was investigated and found to be adequate for limiting personnel exposure to Pu^{239} in the event of an accident to less than the maximum permissible quarterly exposure (MPQE). Continuous alpha air monitors which filter air and count the activity simultaneously are located in each of the four alpha laboratories. Filter paper is changed once each day, and the collected activity is recounted after several days decay to determine low levels of long-lived activity. Since the maximum short-lived alpha background for these monitors over a four month period was 775 counts/min, the instrument will be set to alarm at 1000 counts/min. At this setting the instruments will alarm at 10 to 50% MPQE for Pu^{239}, depending on the short-lived alpha background. A differential meter which records the difference in alpha counts collected by monitors in adjacent laboratories was set to alarm at 250 counts/min, since the maximum observed over the period studied was 215 counts/min. At this setting the instrument will normally alarm at about 12% MPQE. Improved methods for obtaining representative air samples appears to be a more urgent problem than the development of better counting techniques for detecting long-lived alpha activity. (auth)

23551 (PNE-229P) SOME RADIOCHEMICAL AND PHYSICAL MEASUREMENTS OF DEBRIS FROM AN UNDERGROUND NUCLEAR DETONATION. W. B. Lane (Naval Radiological Defense Lab., San Francisco). Aug. 1962. Project 62.90 of PROJECT SEDAN. 54p.

A project is described to collect fallout samples at 2600 to 19,000 ft from ground zero in order to determine the mass per unit area, gamma activity per unit area, particle size distribution, and specific activity versus particle size of the fallout; to determine the gamma decay rate and spectra of the samples; to perform leaching and exchange studies on the radioactive debris; to measure the release of gaseous fission product iodine; and to determine the radiochemical composition of the fallout. Twenty basic collectors (2 ft × 2 ft × 2 in. deep) were placed in the downwind sector at increasing distances. A gas sampler was located approximately two miles downwind. The fallout was well-placed over the station array, and all collectors received significant deposits. Sufficient data were obtained to meet all project objectives. (auth)

23552 (RFP-175) PLUTONIUM HANDLING FACILITIES FOR RADIOGRAPHY. A. L. Dighton, J. C. Sampson, and W. D. Stump (Dow Chemical Co. Rocky Flats Plant, Denver). Apr. 12, 1962. Contract AT(29-1)-1106. 22p.

Since any radiography must be performed in an enclosed system, an enclosed glove box was constructed to facilitate radiographic operations. Tests show that no significant detail is lost in radiographing dense materials greater than 0.020 inch through 0.120 inch of aluminum using energies in the 1 Mev range. (auth)

23553 (RM-3189PR) A METHOD OF COMPUTING THE DISTRIBUTION FUNCTION OF RADIOACTIVE DOSES FROM MULTIPLE NUCLEAR DETONATIONS. E. S. Batten (RAND Corp., Santa Monica, Calif.). Sept. 1962. Contract AF 49(638)-700. 43p. (AD-285975)

A computational method is presented for estimating fallout contamination from multiple nuclear detonations for a small geographical area. The method accounts for the overlapping of fallout patterns encountered in a variety of wind conditions. The method is applied to a typical target system. Limitations imposed by uncertainties in the initial assumptions are discussed. (C.H.)

23554 (SCPRI(A)-75) ORGANISATION PRATIQUE DE LA RADIOPROTECTION EN FRANCE DANS LE CADRE DE LA SANTE PUBLIQUE ET DU TRAVAIL. (Practical Organization of Radioprotection in France in the Framework of Public Health and of Industry). (France. Service Central de Protection contre les Rayonnements Ionisants, Paris). Aug. 1962. 39p.

The formal organization and area of action of the two agencies devoted to radioprotection in the field of public health and in industry are described. The two organizations are the Service Central de Protection contre les Rayonnements Ionisants (SCPRI) and Laboratoire de Measure et de Controle des Rayonnements Ionisants en Milieu de Travail (L.M.C.M.T.). The devices and installations used by the two agencies are tabulated. In appendices the stations, laboratories, and sampling sites of the SCPRI and French legislation relative to radioprotection are reported. (J.S.R.)

23555 (SCPRI(RM)III-63) RAPPORT D'ACTIVITE MARS 1963. (Report of Activities, March 1963). (France. Service Central de Protection contre les Rayonnements Ionisants, Paris). 25p.

The results of the radiological monitoring of the atmosphere, nuclear sites, rain waters, and the food chain are briefly summarized and shown graphically and in tabular form. (J.S.R.)

23556 (TID-16181) CONTROL OF CONTAMINATION IN HIGH LEVEL CAVES AT THE SAVANNAH RIVER LABORATORY. R. C. Craft (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [July 1962]. Contract AT(07-2)-1. 12p.

Methods of controlling contamination in high-level caves at Savannah River Laboratory are presented. A brief summary of recent operating experiences, including cell decontamination procedures, is included. (auth)

23557 (TID-18608) RADIOACTIVE FALLOUT. Annual Progress Report. P. K. Kuroda (Arkansas. Univ., Fayetteville). Dec. 31, 1962. Contract AT(40-1)-2529. 84p.

Isotope ratio data revealed the effect of chemical fractionation of bomb-produced fission products in the atmosphere. The Tc^{99} content of rain water increased from 2 ± 1 to 44 ± 6 muc from 1961 to 1962. The tracer Cd^{109} added in the U. S. high-altitude test of July 8, 1962, could not be detected in rain at Fayetteville, Arkansas, during September 1962. An inverse relationship was observed between the concentration of radiostrontium and the rate of rainfall within a given air mass. Pronounced peaks were observed in Ce^{144} in samples of rain water collected in 1960 and 1961. (C.H.)

23558 (TID-18648) AUTOMATED SMEAR PROGRAM FOR RADIOACTIVE MATERIAL. Merwyn Sanders (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). [nd]. Contract W-7405-eng-26. 12p.

An automated system was devised for taking smear samples in a uranium production facility. The program consists of the following major steps: the taking of smears on standard IBM cards by a specially designed device which standardizes methods of obtaining a sample; counting and recording results from the cards automatically; and automatic tabulation of results for expeditious reporting. The program offers several advantages such as: removing the human element in taking smear samples, since the device used controls smear pressure and surface area samples; providing automatic sample counting and data machine tabulation for fast reporting, as compared to hand counting and data tabulations; and offering the capability of processing 15,000 samples per month at a minimum operating cost with minimum human effort. (auth)

23559 (CEA-tr-X-499) PRÉCAUTIONS À PRENDRE PAR LES INGÉNIEURS CHIMISTES CONTRE LES DANGERS D'IRRADIATION. (Precautions to Protect Chemical Engineers Against Dangers of Irradiation). S. Sakagishi. Translated into French from Bunseki Kagaku, 9: 910-15 (1960). 31p.

An outline is presented of radiation safety of personnel, with attention to: radiation and characteristics of radiation accidents; permissible doses; bases for permissible doses for superficial contamination; fundamentals of the handling of radioactive substances; radioactivity thresholds in the laboratory area; laboratory equipment and safe operational procedures; storage and transport of radioisotopes; decontamination; treatment of radioactive wastes; and first aid for radiation accidents. (T.F.H.)

23560 MEASUREMENT OF THE ABSORBED RADIATION DOSE ON THE THIRD SOVIET SATELLITE SPACESHIP. I. A. Savenko, N. F. Pisarenko, P. I. Shavrin, and S. F. Papkov. AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 1254-5(May 1963). Translated by Jean Findlay from Iskusstv. Sputniki Zemli, No. 13, 81-4 (1962).

The data obtained from two scintillation counters and one gas-discharge counter aboard the third Soviet satellite were reported. The main result is the conclusion that there is practically no danger in space flight at heights less than 350 km over a considerable period of time, in the absence of solar flares. A comparison of the data obtained on the second and third satellite permit practical inferences on radiation danger at greater heights as well. (C.E.S.)

23561 PRE-OPERATIONAL ENVIRONMENTAL SURVEY FOR THE ENRICO FERMI ATOMIC POWER PLANT: 1958-1962. Charles A. Pelletier and G. Hoyt Whipple (Univ. of Michigan, Ann Arbor and National Sanitation Foundation, Ann Arbor, Mich.). Am. Ind. Hyg. Assoc. J., 24: 172-9 (Mar.-Apr. 1963).

A pre-operational Environmental Survey for the Enrico Fermi Atomic Power Plant was begun in April, 1958, and has continued to the present. Data are presented for the spectrometric analysis of air samples showing the fraction of the total activity that can be identified with the gamma-ray spectrometer. The observed variations in radioactivity with time and sampling location are discussed and the gross beta radioactivity concentrations in airborne dust at two Southeastern Michigan locations are shown. Observed relations between the average radioactivity concentrations and the variations from the average are discussed. All the media sampled during the survey are evaluated in terms of certain stated criteria. Conclusions are drawn regarding general suvey methodology, sample media, and the usefulness of the pre-operational survey. (auth)

23562 SOME APPROXIMATION CALCULATIONS FOR AN IRRADIATION FACILITY WITH SIMPLIFIED RADIATION PROTECTION. G. Siewert and H. Stegmann (VEB KPkA, Dresden). Kernenergie, 6: 124-30(Mar. 1963). (In German)

With the calculations it should be shown that by means of a simple mathematical approximation at least an order-of-magnitude estimation of the prevailing radiation field in the region of the irradiation facility can be achieved. If the approximation character of the calculation statement is considered, then a satisfactory order-of-magnitude agreement can be established between calculated and measured values. Of course, for the plan of radiation protection structure according to the described principle of location and function, adjacent buildings must be considered. (tr-auth)

23563 THE CONTROL OVER Cs^{137} SOURCE IN GAMMA-APPARATUS GUTR-Cs—V-400. M. Sh. Vainberg and N. V. Vershinin (Central Medical Inst. for Graduate Work and Inst. of Sanitation and Occupational Disease, Academy of Medical Sciences, USSR). Med. Radiol., 8: No. 2, 73-5(Feb. 1963). (In Russian)

Data relative to sanitary technical investigations of the cesium kilocurie source in the therapeutic gamma apparatus are given. For a period of $2\frac{1}{2}$ years periodic measurements were made of the smears from the working head and butt end of the source, along with the measurements of temperature. The design of the source ensures hermetic union, the working head provides a stable thermal regimen. (auth)

23564 ARTIFICIAL RADIOACTIVITY IN THE BIOSPHERE AND ITS UPTAKE BY MAN. G. W. Barendsen (Gezondheidsorganisatie TNO, Rijswijk, Netherlands). Ned. Tijdschr. Natuurk., 28: 128-38(May 1962). (In Dutch)

The properties of the various types of atmospheric artificial radioisotopes are determined by four factors (the fission yield, half life, possibility of uptake by man, and the radiation output of the isotope). The uptake and characteristics of Sr^{90}, Sr^{89}, Cs^{137}, I^{131}, and C^{14} are described. In conclusion, the origin of external radiation is considered. (J.S.R.)

23565 THE USE OF RESPIRATORS FOR PROTECTION AGAINST AIRBORNE RADIOACTIVITY. S. T. Hermiston (United Kingdom Atomic Energy Authority, Windscale, Cumberland, Eng.), R. F. Hounam, and R. P. Rowlands. p.160-9 of "Design and Use of Respirators." New York, Pergamon Press, 1962.

Details are given of the various types of respirators and self-contained breathing apparatus in current use within the United Kingdom Atomic Energy Authority. Practical experience of the use of respirators in industrial conditions is described together with a discussion on the problems which arise as a consequence of providing operational respiratory protection. Criticisms are made of the design at present used and ideal requirements are suggested for a respirator suitable for factory conditions. The question of facepiece leakage is discussed in the light of the results of British and American experiments. Reference is made to Canadian experience with the use of respirators in areas contaminated with radioactivity. The paper concludes with the specification that an ideal respirator would be one which had a protection factor of 1000 and, on prac-

tical tests to measure the overall performance of the complete equipment, this protection factor would be demonstrated in not less than 999 cases out of 1000. It is believed that there is little difficulty in producing components of suitable performance but that improvements in mask design are still required to ensure a satisfactory seal on the majority of faces. (auth)

23566 RADIUM ISODOSEN: DIE RADIUMDOSIERUNG IN "r". (Radium Isodoses: Radium Dosage in "r"). A. Verhagen. Stuttgart, Georg Thieme Verlag, 1958. 103p. (Text in German and English). DM 19.50.

Dose distribution in radium therapy is discussed and an isodose atlas is presented. (TCO)

23567 NUCLEAR SAFETY. Volume 4, No. 3. William B. Cottrell, ed. (Oak Ridge National Lab., Tenn.). Mar. 1963. $0.55(GPO) (domestic), $0.70(GPO) (foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC).

A total of 18 papers are presented on various aspects of nuclear safety. Some of the aspects are failures in piping, stress-corrosion cracking of stainless steel, the SL-1 accident, instrumentation, high-efficiency filters, fission product release, fallout incidents, tritium hazards, the PM-3A plant fire, and licensing regulations. (D.L.C.)

23568 FAILURES IN HIGH-TEMPERATURE HIGH-PRESSURE PIPING. Helmut Thielsch. p.1-24 of "Nuclear Safety. Vol. 4, No. 3."

Experiences with piping system failures in commercial steam power plants are described with a view to foretelling possible problems in nuclear power plants in the future. Different causes of service failures are discussed: design, materials selection, manufacture and shaping of materials, final fabrication and welding, excessively severe service conditions, and incorrect material identification. The problem of increasing failures and the need for realistic quality specifications and inspection are considered. (D.L.C.)

23569 AEROSPACE NUCLEAR SAFETY PROGRAM. W. K. Kern and G. B. Connor. p.25-8 of "Nuclear Safety. Vol. 4, No. 3."

A program is being conducted on the safety of the operation of reactors and radioisotopic thermoelectric generators, particularly SNAP devices, in space. The possible aerospace environments to which the devices might be subjected are outlined, and the scope of the program is described. The ground environment studies, flight tests, and excursion tests are discussed. (D.L.C.)

23570 JCAE HEARINGS ON RADIATION STANDARDS, INCLUDING FALLOUT. William B. Cottrell. p.28-31 of "Nuclear Safety. Vol. 4, No. 3."

On June 4 to 7, 1962, the Joint Committee on Atomic Energy held public hearings on radiation hazards and standards for protection against them. Some of the highlights and trends presented in testimony at the hearings are discussed. These highlights include industrial radiation protection standards, I^{131} in milk, and prediction of exposure from fallout. (D.L.C.)

23571 STRESS-CORROSION CRACKING OF STAINLESS STEEL. J. C. Griess. p.32-5 of "Nuclear Safety. Vol. 4, No. 3."

Reactors of nearly all types have experienced stress-corrosion cracking of austenitic stainless-steel components. Some of the recorded incidents and the conditions of their occurrence are summarized. The stainless steel components include heat exchangers, fuel elements, pressure vessels, etc. Stress-corrosion cracking of hardened 17-4 PH stainless steel is also discussed. Ways of preventing the cracking are considered briefly. (D.L.C.)

23572 POWER-REACTOR STABILITY EXPERIENCE. P. N. Haubenreich. p.35-8 of "Nuclear Safety. Vol. 4, No. 3."

A review is presented of stability experiences in several power reactors. These experiences include the fast positive power coefficient of the second SRE core due to fuel rod bowing, the low-speed instability of HTRE, transient analyses in Yankee and Shippingport reactors, and the xenon instability in Shippingport reactor. The use of noise analysis to derive information on reactor stability is discussed. (D.L.C.)

23573 POSTINCIDENT ANALYSIS OF SOME ASPECTS OF THE SL-1 DESIGN. W. J. Kann, D. H. Shaftman, and B. I. Spinrad. p.39-48 of "Nuclear Safety. Vol. 4, No. 3."

An analysis is made of the safety aspects of the SL-1 control systems with reference to future reactor design. The reactor components of SL-1 are described briefly, and preincident system malfunctions are discussed. The procedure for the assembly of a drive to a control rod is given. A critique is made of the control system design philosophy. It is concluded that two design decisions made the SL-1 incident possible: the acceptance of a design in which the reactor could be made supercritical by the removal of a single control element and the use of manual manipulations to effect assembly or disassembly of the control rods. Bottom mounting of control rod drives, soluble poison control, and an emergency shutdown system are recommended for future design. (D.L.C.)

23574 ROLE OF LOG N PERIOD METER IN REACTOR PROTECTION. J. L. Anderson. p.48-50 of "Nuclear Safety. Vol. 4, No. 3."

The difficulties in the use of period meters are described briefly, and the role of the period meter in the augmentation of the safety system is discussed. The time response graph of the ORNL-Q-915 log N period meter is plotted. It is emphasized that period scrams are most valuable for low-power excursions. A recently developed meter with fast response at high power levels and with a negative period scram is criticized. (D.L.C.)

23575 REACTOR BEHAVIOR ANALYSIS USING ANALOG COMPUTERS. O. W. Burke. p.50-2 of "Nuclear Safety. Vol. 4, No. 3."

The report of Holley Carburetor Co. on the system analysis and simulation of the Enrico Fermi power plant is reviewed briefly. The devices used to simulate various components and phenomena of the plant are described briefly. (D.L.C.)

23576 ROLE OF NEUTRON SOURCE IN REACTOR SAFETY. S. H. Hanauer. p.52-5 of "Nuclear Safety. Vol. 4, No. 3."

The importance of the neutron source in reactor startups is discussed, and it is shown that the source must be of sufficient strength so that the reactor behavior will be governed by the kinetic equations. The necessity of reactor source instruments detecting only neutrons from the source and not electrical noise is pointed out. Natural neutron source levels in reactors are discussed. (D.L.C.)

23577 IN-PLACE TESTING OF HIGH-EFFICIENCY FILTERS. R. W. Schneider. p.56-8 of "Nuclear Safety. Vol. 4, No. 3."

The importance of testing the efficiency of a filter system is pointed out, and the techniques used at ORNL for in-place testing of filter systems are described briefly.

Probing for the source of leakages in the event of an unsatisfactory efficiency is considered. The results of in-place tests at ORNL are tabulated; they show that in-place testing of multifilter installations is particularly important. (D.L.C.)

23578 FISSION-PRODUCT VAPORIZATION AND DEPOSITION FROM URANIUM CARBIDE. Stanley Cantor. p.58-62 of "Nuclear Safety. Vol. 4, No. 3."

A review is presented of recent studies on the vaporization of fission products from uranium carbide–graphite fuel into helium coolant. It is shown that the significant fission products likely to be present in the coolant are Kr, Xe, I, Br, Te, Se, Cs, Rb, Sr, Ba, Sm, Eu, and, from the decay of their volatile precursors, Y, La, Ce, and Zr. The sorption of alkali and alkaline-earth metals on graphite is considered. Some of the predictions made on the deposition of fission products are given. It is concluded that more experimental information is needed on the effects of chemical reactions on the vaporization and deposition of fission products. (D.L.C.)

23579 PARTICLE AND FISSION-PRODUCT BEHAVIOR IN NUCLEAR ACCIDENTS. R. E. Adams, C. J. Barton, W. E. Browning, Jr., and G. W. Parker. p.62-8 of "Nuclear Safety. Vol. 4, No. 3."

The importance of fission-product release studies in reactor siting and hazards evaluation is pointed out. A review of these studies is presented which is divided into sections dealing with particle production and behavior, fission-product release and behavior, and containment and removal of fission products from the atmosphere. The I^{131} release in the SL-1 accident is considered briefly. (D.L.C.)

23580 NUCLEAR SAFETY IN FALLOUT SITUATIONS. Gordon M. Dunning. p.69-77 of "Nuclear Safety. Vol. 4, No. 3."

A review is given of three fallout incidents in which countermeasures were taken. These incidents were: (1) the multimegaton shot BRAVO in Bikini Atoll, after which some islanders were evacuated; (2) the 32-kt HARRY shot at the Nevada Test Site, after which the inhabitants of St. George, Utah, were asked to remain indoors for 2 hr; and (3) the increase in I^{131} in milk in Salt Lake City after the SEDAN shot, in which case the milk industry took steps to reduce the I^{131} content. The reasons for each countermeasure are outlined. It is shown that the actions undertaken on the milk in Salt Lake City were in large measure unnecessary, as the Federation Radiation Council figures prompting the actions are very conservative and were to serve only as guides. (D.L.C.)

23581 TRITIUM HAZARDS IN HEAVY-WATER-MODERATED REACTORS. H. L. Butler. p.77-82 of "Nuclear Safety. Vol. 4, No. 3."

A review is presented of the hazards of tritium in D_2O reactors and of the practices taken to counteract these hazards. These practices cover reactor facility design, training, protective equipment, and instrumentation for tritium detection in air, on surfaces, and in biological samples. (D.L.C.)

23582 SL-1 FINAL REPORT. J. R. Buchanan. p.83-6 of "Nuclear Safety. Vol. 4, No. 3."

The final report issued by the AEC's Board of Investigation on Sept. 5, 1962, is discussed. The accomplishments of the three recovery phases are described. Some statements made to the Board by Combustion Engineering, Inc., and Argonne National Laboratory are given. It was concluded by the Board that the direct cause of the incident was manual withdrawal of the central-rod blade beyond the specified limit and that the actual reason for the withdrawal is not known. (D.L.C.)

23583 PM-3A NUCLEAR POWER PLANT FIRE. J. R. Buchanan. p.86-8 of "Nuclear Safety. Vol. 4, No. 3."

On Oct. 7, 1962, a flash hydrogen fire occurred inside the containment tanks of the PM-3A Plant at McMurdo Sound, Antarctica. The events on the day of the fire are described. The damage by the fire was largely superficial, and it was determined that the fire was caused by an accumulation of hydrogen ignited by an instrument short circuit. The possible sources of hydrogen are described, and the actions taken to prevent future accumulations of explosive mixtures are outlined. (D.L.C.)

23584 CHANGES IN LICENSING REGULATIONS. J. R. Buchanan. p.89-90 of "Nuclear Safety. Vol. 4, No. 3."

A brief review is presented of amendments and changes in the AEC rules and regulations published in the Code of Federal Regulations. These changes cover rules of practice; radiation protection; licensing of by-product material, source material, and production and utilization facilities; review of exempted reactors; and transfer of regulatory authority to states. (D.L.C.)

23585 ACTION ON REACTOR PROJECTS BY LICENSING AND REGULATING BODIES. J. R. Buchanan. p.90-8 of "Nuclear Safety. Vol. 4, No. 3."

The regulatory responsibility of AEC in approving and disapproving reactor projects is outlined. The license application record of U. S. power reactors is tabulated. Recent actions and activities on specific reactors are also described. (D.L.C.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

23586 (AEEW-R-149) AN EXPERIMENTAL STUDY OF THE BEHAVIOUR AND DETECTION OF HAZARDOUS RADON RELEASES IN AIR. J. F. Croft and K. E. G. Perry (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1962. 88p.

A series of experiments are described involving airborne concentrations of Rn-222 up to 10^{-4} $\mu c/cm^3$. The response of a variety of standard health physics instruments to the α and β/γ emissions from the Rn-222 and its daughter products was evaluated. An assessment was made of the physical form of the airborne daughter products. Free-ion fractions of RaAr were found which suggest that the maximum permissible exposure to Rn-222 and its daughter products, under accident conditions, should be reduced from 6×10^{-5} to 6×10^{-6} μc-hrs/cm^3. Effective deposition velocities were evaluated separately for free-ion RaAr and for particulate-carried daughters. (auth)

23587 (BNL-790) PROCESS RADIATION DEVELOPMENT PROGRAM SUMMARIES. Third Annual Contractors Meeting, April 22-23, 1963, Held at Brookhaven National Lab., Upton, N. Y. (Brookhaven National Lab., Upton, N. Y.). Contract [AT(30-2)-Gen-16]. 66p. (BNL-C-37)

Program summaries are included on radiation dosimetry by metal-organic bond radiolysis, radiosynthesis of halogenated compounds, radioinduced reactions in swollen polymers, combined radiation and high-pressure effects on organic monomers and polymers, gamma-ray effects on wood, semiconductor fabrication, radioisotope applications, radioinduced gelation of monomer-polymer mixtures, radiation handbook development status, radiation applications in textile production, radioinduced coal oil synthesis, high-intensity radiation laboratory operation, radioinduced electrical breakdown in glass, radioinduced graft polymerization, radioinduced formation of organo-tin compounds, development of high-dielectric-constant polymers, radiation processing research, post-effect polymerization, radiation effects on colloidal systems radiation technology studies, and radioinduced polymerization of unusual monomers. (J.R.D.)

23588 (LAS-SR-161-60) RADIOISOTOPES RESEARCH, DEVELOPMENT, AND RELATED ACTIVITIES. Quarterly Progress Report, December 15, 1962 to March 15, 1963. (Chicago. Univ. Labs. for Applied Sciences). Apr. 1963. Contract AT(11-1)-712. 16p.

During the seventeenth quarter, December 15, 1962 to March 15, 1963, the effort on radioisotopes research, development, and related activities, was primarily expended on report preparation. Work sheets developed in neutron-moderation moisture determination in coal for the convenient computation of linear regression coefficients are included. Delivery dates in April were obtained for alpha sources. Alpha scattering data in the published literature were accumulated. (auth)

23589 MEASUREMENT OF SELF-DIFFUSION COEFFICIENTS IN SOLIDS BY SELF-ABSORPTION OF β RAYS IN SAMPLES OF FINITE THICKNESS. Jean-Pierre Renouf, Pierre Fouilloux, and Paul Bussière (Institut de Recherches sur la Catalyse, Villeurbanne, France). Compt. Rend., 256: 3290-1(Apr. 8, 1963). (In French)

The generalization of the Krioukov and Zhoukhovitski equation leads to a function (difficult to use) of the absorption coefficient μ for the material studied. A new non-destructive method giving, independently of μ, a simple relation between the diffusion coefficients and the intensity of the radiation transmitted by the simple marked discharge face is proposed. The advantages of this method are discussed. (tr-auth)

23590 RESULTS IN PRODUCING CLOSED RADIATION SOURCES IN HUNGARY. [PART] I. Cserep Gyoergy and Stenger Vilmos. Energia Atomtech., 16: 140-3(Mar. 1963). (In Hungarian)

Considerable effort was devoted to the development of the scientific foundation of a radioactive source industry in Hungary; these sealed β or γ sources are widely applied in industry, especially for the fabrication of thickness gages used in the cardboard, plastics, rubber, and metal-foil industry. The Co^{60} sources are prepared by irradiating a Co–Ni alloy, or sometimes even pure Co, in the Hungarian reactor. The activated metal is sealed in an epoxy resin and cured at 180°C. Zn^{65} sources are somewhat less used because of their shorter half life and lower specific activity. The isotope is prepared by the irradiation of Zn^{64} in a cyclotron or reactor; the activated metal is treated like the Co^{60}. The Cs^{137}, the γ-radiation of which is due to the Ba^{137} formed during its decay, is prepared by separating it from the fission products of U; it is used in the fabrication of sealed sources in the form of its salts. Contamination of the external surface was noted with imported foreign sources, due to migration of the active material as a result of the corrosion of the container. This problem was avoided by preparing the source in the following manner: powdered, low-melting glass was impregnated with the Cs^{137} solution, then the mixture was dried, melted, and encapsulated. An alternate method consisted in the impregnation of a porous ceramic rod. Ir^{192} sources, prepared by the irradiation of Ir^{191}, were found useful because of the good chemical resistance of Ir. (TTT)

23591 USE OF RADIOACTIVE ISOTOPES IN DETERMINING THE COMPACTNESS OF CONCRETES MANUFACTURED FROM LOCAL MATERIALS. F. Gobesz. Lucrari Stiint. Inst. Politeh. Cluj, 117-39(1960).

The compactness of concrete manufactured from local materials was determined by passing gamma rays through it. The experimental data correspond closely to the theoretical. With the correct setting up of the apparatus, an accuracy of ±1% was possible. (Referativnyy zhurnal, Khimiya, No. 3, 1962)

23592 A CONTAINER FOR A RADIUM–BERYLLIUM NEUTRON SOURCE. Teiji Uemura and Noboyuki Furuhashi. Radioisotopes (Tokyo), 11: 328-30(Aug. 1962). (In Japanese)

The container of a 10 millicurie Ra–α–Be-neutron source which keeps the radiation dose at about 2 mrem/hour on its surface was closely examined. Removal cross sections by Hornyak buttons yielded the following results:

0.0055 cm^2/g for Pb; 0.0135 cm^2/g for Fe; and 0.110 cm^2/g for paraffin. The calculations indicated that 10 cm of Pb and 15 cm of paraffin are sufficient to shield the container; however, if a 10-cm thick concrete layer is used, 7 cm of Pb and 10 cm of paraffin are sufficient. (TTT)

23593 INVESTIGATION OF FLUID PHASE DENSITY AT HIGH PARAMETERS BY MEANS OF γ-RADIOGRAPHY. I. Kh. Khaibullin and N. M. Borisov (Krzhizhanovskii Inst. of Power Engineering, USSR). Teploenerg., No. 2, 78-82 (Feb. 1963). (In Russian)

Gamma radiography is suggested for determining the density of a salt-water-steam system at high parameters. The results obtained using $NaCl-H_2O$ solutions at 1 to 400 atm pressures are analyzed. (R.V.J.)

INSTRUMENTS AND INSTRUMENTATION

General and Miscellaneous

Refer also to abstract 24638.

23594 (BNL-6235) THE FAST RISE PULSER. George Kiriokos (Brookhaven National Lab., Upton, N. Y.). June 26, 1962. Contract [AT(30-2)-Gen-16]. 2p.

The design of the circuit for the fast-rise pulser is presented. For stability, a variable sawtooth generator is used in the first stage. This drives a one-shot multivibrator which stretches the pulse to operate the Clare Relay. The second stage of the one-shot multivibrator and the 2N301 are d-c coupled to eliminate a multitude of components. The output pulse is 18 volts in amplitude, is 1 μsec wide, and has a 10-nsec rise. (N.W.R.)

23595 (CERN-63-5) MILADY — UNE TABLE DE PRÉMESURES POUR LE H.P.D. (MILADY — A Table of Preanalysis for the H.P.D.). M. Benot, G. Durupthy, P. Giraud, J. Guillaume, L. Sohet, and R. Zurbuchen (European Organization for Nuclear Research, Geneva). 1963. 48p.

The perfection of a new automatic device for the analysis of track photos (the Hough-Powell device) necessitated a new consideration of the problem of rapid measurement and limited precision on a scanning table. The design and construction of a digitized scanner MILADY for use with the H.P.D. are described. The principles and requirements of the device are first discussed. The system used for film transport and photo counting is described. The electronic control apparatus for the scanner is analyzed. In conclusion, the precision and efficiency of the device are determined. (J.S.R.)

23596 (IS-645) MEASUREMENT OF THERMAL PROPERTIES BY THE ARC IMAGE FURNACE. W. R. McMahon and D. R. Wilder (Ames Lab., Ames, Iowa). Apr. 16, 1963. Contract W-7405-eng-82. 20p.

A number of imaging furnace systems and sources are discussed with emphasis on the carbon arc image furnace. Several potential applications of the carbon arc image furnace in high temperature research are described, and a new method of heat capacity determination is discussed. (auth)

23597 (K-1444) AN AUTOMATIC MASS SPECTROMETER FOR RELATIVE MEASUREMENTS OF URANIUM ISOTOPES. A. Langdon and H. A. Kermicle (Oak Ridge Gaseous Diffusion Plant, Tenn.). May 20, 1963. Contract W-7405-eng-26. 17p.

A mass spectrometer is described for making automatic relative measurements of uranium isotopes. The major features for operating several spectrometers of this type concurrently are discussed. The instrument is programed to make a determination in 13.5 min, and a digital ratiometer and printer in the measuring system provide printed data output. The cost of making ratio-of-ratios determinations is reduced over 40%, the variance of a determination is lowered by a factor of 2.5 for the measurements usually made, and the cost of maintaining the automatic spectrometers is 30% less. (auth)

23598 (LA-2853) NET-1 NETWORK ANALYSIS PROGRAM. Allan F. Malmberg and Fred L. Cornwell (Los Alamos Scientific Lab., N. Mex.). Mar. 4, 1963. Contract W-7405-eng-36. 154p.

NET-1, a computer program for simulating and analyzing d-c steady state behavior and the transient behavior of a large class of electrical circuits containing passive and solid state components, is discussed. Preparation of input for the NET program, the interpretation of results, and operating details are explained. The models, or equivalent circuits, of diodes and transistors in the NET program and parameters controlling the behavior of the models are discussed. Auxiliary computer programs that facilitate preparation of input and processing of output in the NET program are also examined. (auth)

23599 (LADC-5331) INSTRUMENTATION IN A RESEARCH LABORATORY. James R. Lilienthal and J. T. Simmons (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 11p.

The operations of the Instrument Section of the Los Alamos Scientific Laboratory are reviewed with respect to the general nature of the scope and methods used in instrumentation. The equipment, procedures, and facilities are discussed. (N.W.R.)

23600 (LADC-5476) A "JUKE-BOX" SAMPLE CHANGER WITH PUNCHED-TAPE CONTROLLED SEQUENCING. C. G. Chezem and H. H. Helmick (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 15p.

A phonograph was converted to a foil changer and the most suitable changer mechanism, which was normally packaged in a plywood cabinet and designed to play hi-fidelity stereo recordings through external speakers, was chosen. The playing arm and turntable were replaced by lead shields designed to completely enshroud NaI(Tl) crystals and photomultiplier assemblies. The 45-rpm recordings were replaced by steel discs, which serve as foil holders and additional gamma ray shielding. Electromagnets were mounted in the lead shields to hold the discs in reproducible positions. Only a minor modification was made to the standard power supply while the stereo amplifiers were replaced by an identical box containing control circuits for the programing system, which permits automatic insertion and storage of a new address while the previous foil is being counted. Actual operation of the system is described. (P.C.H.)

23601 (LNF-62/111) INDAGINE PRELIMINARE SULL'ANDAMENTO DELLA CURVA DI DISCRIMINAZIONE DEL DISCRIMINATORE A DIODO TUNNEL IN FUNZIONE DEL VALORE DEGLI ELEMENTI PARASSITI DEL DIODO STESSO. (Preliminary Investigations on the Behavior of the Discrimination Curve of a Tunnel Diode Discriminator as a Function of the Value of the Parasitic Elements of this Diode). Note No. 177. M. A. Locci, F. Pandarese, and M. Puglisi (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Dec. 22, 1962. 17p.

The basic parameters by which the dynamic behavior of a tunnel diode discriminator can be described are defined. The quantitative limitations sufficient to guarantee variations of the discrimination threshold in dynamic conditions to less than 5% of the value of the static threshold are reported. A factor of merit is proposed. (tr-auth)

23602 (LNF-63/1) APPARATO DIGITALIZZATORE DI AMPIEZZE CON USCITA IN STAMPA. (Amplitude Digitizer with Printed Output). Note No. 180. M. Coli, C. Dardini, A. Odian, and F. Pandarese (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Jan. 18, 1963. 19p.

The ELE-DIGO-162 consists of a pulse-height digitizer (DIG/DO) and of a memory device (MEM/CP) with luminous read-out and subsequent printing. The digitizer is constructed of two distinct parts; one is an oscillator with 32 pulses per 5 v pulse height and the other is a start-stop trigger for the following memory counter. The MEM/CP is a memory counter with luminous read-out. This can be considered the input unit for the Hewlett-Packard 561-B printer. It consists of an 11-decade counter with independent input; one channel of the printer corresponds to each decade of the counter. The apparatus and following printer can accept information from 4 different counter columns using two channels of the unit for the two counting ciphers. The remaining three channels can be used for the subsequent classification of the number of events printed. (J.S.R.)

23603 (LNF-63/2) DISPOSITIVO PER IL RILEVAMENTO DI COORDINATE DI CAMERA A SCINTILLA, IN FORMA NUMERICA, CON REGISTRAZIONE SU SCHEDE. (Apparatus for Tracing Coordinates of Scintillation Cameras in Numerical Form with Recording on Cards). Note No. 181. M. Coli and A. Vignati (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Jan. 21, 1963. 15p.

An apparatus for tracing the coordinates of a graph or of the traces of scintillation cameras in numerical form with card perforation was described. The device is called a coordinatograph. The operational principles are first described. The methods used for the test measurements and some results of coordinate tracing are then considered. The construction, control systems, and control circuits are discussed in conclusion. (tr-auth)

23604 (LNF-63/3) LA MISURA DI ALTI CAMPI MAGNETICI MEDIANTE L'EFFETTO FARADAY. (The Measurement of High Magnetic Fields Using the Faraday Effect). Note No. 182. A. Bonanni and G. Sacerdoti (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Jan. 22, 1963. 19p.

A method for measuring pulsed magnetic fields by using the Faraday effect is described. With this method an instrument can be constructed for the digital-based measurement of pulsed fields. The sensitivity of the measurement is proportional to the value of the magnetic field to be measured, and the resolving power is of the order of 0.22 Wb/m^2 per pulse. (J.S.R.)

23605 (LNF-63/4) MAGNETE PER CAMERA A DIFFUSIONE. (Magnets for Diffusion Chambers). Note No. 183. R. Garfagnini, G. Piragino, and G. Sacerdoti (Italy. Comitato Nazionale per l'Energia Nuclear. Laboratori Nazionali, Frascati). Jan. 28, 1963. 12p.

An analyzing magnet for the Torino diffusion chamber was constructed, and its characteristics are tabulated. Cross sections of the complete installation are shown. Measurements show that the percentage variation of the magnetic field as a function of the distance from the magnet center is constant in the field values studied. (J.S.R.)

23606 (MATT-187) CLADDED LAMINAR OPTICS FOR THE ULTRAVIOLET. J. G. Hirschberg (Princeton Univ., N. J. Plasma Physics Lab.). Apr. 1963. Contract AT(30-1)-1238. 6p

Inability of ordinary multislit monochromators to transmit in the ultraviolet for studies of spectral lines in plasmas is noted, and use of fused silica sheets (laminas) coated with a dielectric material with a lower refractive index than the silica is proposed. Fused quartz coated with MgF by vacuum evaporation performed well in experiments. (D.C.W.)

23607 (ML-918) CYCLOTRON RESONANCE INTERACTION AT MILLIMETER WAVELENGTHS. Scientific Report No. 43. K. K. Chow (Stanford Univ., Calif. Microwave Lab.). Aug. 1962. Contract AF 19(604)-1930. 46p. (AD-286326)

Cyclotron resonance interaction between an electron beam and a circuit wave to produce backward wave oscillation in an unloaded waveguide in the S-band was investigated, and the development of a prototype oscillator tube to work in the 6 to 4.5 mm range was also completed. This prototype tube was so constructed that it could be placed in a narrow air gap of an iron-core electromagnet which provided the necessary field for electron cyclotron motion. However, it did not have the desired performance. Modifications made on the prototype tube and tube performance after modification are described. A different design is also reported. The main difficulty encountered in improving tube performance was the inability to control electron injection properly. Even at the conclusion of the experimental work described here, the control was not entirely satisfactory, though net electronic gain from the tube was obtainable. A secondary difficulty was the lack of space in which to place the tube components; however, this was later solved. (auth)

23608 (RADC-TDR-62-486) A THEORETICAL ANALYSIS OF THE NOISE PERFORMANCE IN PARAMETRIC CYCLOTRON-WAVE AMPLIFIERS. Technical Note No. 10. Erling Sunde (Norway. Forsvarets Forskningsinstitutt, Kjeller). July 2, 1962. Contract AF61(052)-531. 26p. (AD-285469)

The calculation of noise in a parametric cyclotron-wave amplifier of the quadrupole type is presented. The analysis is correct to second order in the pump amplitude. The calculated noise temperature of the amplifier consists of two terms, the first being proportional to the cathode temperature, and the second proportional to the factor γ^2, where γ^2 is the space-charge smoothing factor accounting for the smoothing of position noise taking place at the potential minimum in front of the cathode. It is shown, by means of design parameters for three different tubes, that the noise temperature of the parametric quadrupole amplifier seems to increase rapidly with frequency. The noise temperature is also shown to be proportional to the pump power. (auth)

23609 (SCTM-76-63(24)) A MAGNETIC PULSE GENERATOR AS A DRIVER FOR MAGNETIC LOGIC. E. J. Bernard (Sandia Lab., Albuquerque, N. Mex.). May 1963. Contract AT(29-1)-789. 39p.

A hybrid pulse generator capable of supplying advance and prime pulses for 50-bit magnetic logic circuits is described. The device can operate on the low supply voltages used with transistor circuits. Saturable reactors and semiconductors are used as switches to control the charging and discharging of capacitors in this circuit to generate short-duration, high-current pulses. Temperature tests showed satisfactory operation over a temperature range of −55 to 85°C. A step-by-step design of a typical unit is presented. (auth)

23610 (SCTM-365-61(73)) ELECTRICAL RESISTANCE STRAIN GAGES APPLIED TO SPECIAL PROBLEMS.

P. H. Adams and R. C. Dove (Sandia Corp., Albuquerque, N. Mex.). Aug. 1962. Contract AT(29-1)-789. 41p.

Literature dealing with the use of strain gages in unusual applications and environments is surveyed. Abstracts and references to articles on the use of strain gages on nonmetallic materials, in medical research, to measure residual stresses, and in the construction of transducers are also included. (D.C.W.)

23611 (TID-13798) DESIGN CHARACTERISTICS OF BEAM CURRENT MONITORS. M. E. Abdelaziz (Argonne National Lab., Ill.). Jan. 26, 1961. Includes PART II. July 24, 1961. Contract W-31-109-eng-38. 31p.

I. Design of current pulse transformers used to measure currents in high voltage connectors without disturbing the circuits and to measure nondestructively beam currents from ion sources in operation with accelerators is briefly discussed. Experimental characteristic curves of such transformers located at the exit of the ion source, the end of the preaccelerator, the linac entrance and exit, the entrance to a chromatic magnet, and the inflector entrance and exit are given and are examined. For a given pulse duration, detection sensitivity is seen to increase with the transformer loading resistance, but the droop of the pulse top increases at high sensitivities. The droop also increases with pulse duration, and threshold pulse width increases with the loading resistance. For a specified droop an increase in the core cross sectional area gives higher detection sensitivity and increases the range of pulse duration. II. Design, therefore, necessarily involves a compromise between wave shape and detection sensitivity. In an experimental study of beam monitor calibration for operation with the final machine, elimination of the droops improved detection sensitivity without affecting the pulse wave shape. Calibration curves obtained with transformers with different windings and carrying various currents are included. (D.C.W.)

23612 (TID-16188) WIDE-BAND CURRENT-SENSITIVE PREAMPLIFIER FOR PHOTOMULTIPLIERS. I. S. Sherman (Argonne National Lab., Ill.). May 1962. Contract [W-31-109-eng-38]. 3p. (UAC-6431)

A wide-band current-sensitive preamplifier with a nonlinearity of less than 2%, output noise from circuit components less than 1 mv, and very low distortion of 1-μsec-rise time current pulses is described. The device was developed for use with photomultipliers in measuring radioinduced chemical changes. (D.C.W.)

23613 (TID-18574) MOISTURE MONITOR TESTING AND CALIBRATION. C. D. Montgomery, J. M. Googin, and L. R. Phillips (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Mar. 14, 1963. Contract W-7405-eng-26. 26p.

Electrolytic moisture monitors which continuously analyze the moisture content of gases are commercially available. After a period of operation, these instruments may give erroneous readings, frequently because of damage to the electrolytic cell. A gas with a known and reproducible moisture content within the operating range would be useful for making operational response tests on these monitors and for checking their calibration. A paired-hydrate system of a chemical compound exhibits a water vapor pressure that is constant at a constant temperature. If an unreactive gas is allowed to equilibrate with a paired-hydrate system, the moisture content of the gas is determined by the vapor pressure of the hydrate pair, the total pressure, and the temperature. Hydrated magnesium perchlorate was prepared which contained between four and six moles of water per mole of perchlorate. This material was pulverized lightly then packed into a stainless steel column and 100 cc/minute of air at atmospheric pressure was passed through the bed. The exit air from the column was analyzed with a moisture monitor. A gas residence time of two minutes in the column was found to be sufficient for establishing moisture equilibrium in the exit flow. The moisture content of the exit air was found to vary from 34 to 70 ppm by volume as the temperature of the paired-hydrate system varied from 20 to 28°C. Other paired-hydrate systems can extend this range to higher moisture levels. (auth)

23614 (TRG-Report-515) A BASIC TRAINING SCHEME. PART III. CALIBRATION AND ADJUSTMENT OF ELECTRICAL RECORDERS: PROJECTS. R. A. Chapman (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). Mar. 21, 1963. 31p.

The response of a pressure-type thermometer, resistance thermometer bulb, and thermocouple to changing temperature was investigated. An introduction to automatic cold-junction temperature compensation is given using an edgewise temperature indicator as an example. This is followed by a calibration of a millivolt recorder treating the recorder as a black box and emphasizing the analogous features in this and previous projects. The projects lead through various potentiometric recorder measuring circuits finishing with a potentiometric temperature recorder. (P.C.H.)

23615 (USASRDL-TR-2272) NUCLEAR/WEATHER CLOUD INDICATOR. William G. Stone (Army Signal Research and Development Lab., Fort Monmouth, N. J.). Apr. 1962. 29p. (AD-285114)

A detailed discussion is presented of the design, development, construction, and performance of an experimental model of a nuclear/weather cloud detector unit to be used with a radar set such as the AN/CPS-9, and to be utilized as an electronic device for the detection and analysis of nuclear clouds or of slow and small changes in weather patterns. The equipment receives radar weather data from the radar PPI display, stores, and compares it with real-time radar information. The difference between real-time and stored data as displayed by the indicator unit represents movement of information, whether it be weather cloud or the instantaneous occurrence of a nuclear cloud. (auth)

23616 COMMENTS ON THE VALIDITY OF BALLISTIC PENDULUM MEASUREMENTS WITH PULSED PLASMA ACCELERATORS. D. L. Clingman and T. L. Rosebrock (General Motors Corp., Indianapolis). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 1233-5(May 1963).

The pendulum configuration was suggested as a possible fault in a previous condemnation of the ballistic pendulum as a useful momentum measurement tool with pulsed plasma accelerators. A ballistic pendulum was presented in which the entire discharge system of a rail-type plasma accelerator, including the electrodes, is surrounded completely by the pendulum bob. With this arrangement, any momentum components due to surface sputtering of the pendulum are cancelled through multiple collisions with the walls, with the possible exception of a negligible error introduced by impingement of sputtered mass onto the electrodes. (C.E.S.)

23617 AN AUTOMATIC NUCLEAR QUADRUPOLE RESONANCE SPECTROMETER. E. Rodrigues and J. B. de Oliveira e Souza (Núcleo de Estudos e Pesquisas

Científicas, Rio de Janeiro). Anais Acad. Brasil. Cienc., 34: 449-54(1962). (In English)

An automatic-recording radiofrequency spectrometer that may be used either as a super-regenerative or autodyne oscillator in nuclear quadrupole or nuclear magnetic resonance studies is described. The oscillator consists of a cathode-coupled double triode in which regeneration is obtained by use of a small adjustable variable capacitor. Frequency modulation is obtained using a small vibrating coaxial capacitor installed inside the transmission line and connected in parallel to the tuning condensers and driven by an external audio oscillator whose frequency and amplitude may be controlled at will. The superposing amplitude modulated signal accompanying frequency modulation was eliminated by mixing the resultant modulated signal and the audio modulating signal properly phased and amplitude controlled in the audio preamplifier stage. Automatic linear sweeping of the frequency range was obtained by coupling mechanically a variable condenser to the paper drum of a recorder. The synchronous detection of the resonance signal was accomplished using a telegraphic relay fed by the same signal used for frequency modulation by properly adjusted in phase and amplitude. There was no ambiguity in the determination of the central frequency if three superposing runs were made with different quench frequencies. (M.C.G.)

23618 THE APPLICATION OF A NEUTRON IDENTIFICATION CIRCUIT TO THE STUDY OF FAST-NEUTRON INTERACTIONS IN STILBENE. F. A. Johnson (Defence Research Chemical Labs., Ottawa). Can. J. Phys., 41: 793-811(May 1963). (DRCL-398)

A neutron identification circuit is described that has a threshold corresponding to a neutron energy of about 350 kev. The photomultiplier is operated under conditions of space-charge saturation. Selection of pulses due to recoil protons or heavier particles is accomplished by allowing the initial negative-going spike of the space-charge-limited pulse from the last dynode to activate a trigger circuit, the output of which is used to gate the subsequent positive portion of the dynode pulse for presentation to a simple diode discriminator. Separation of pulses due to recoil protons and to α particles is also possible to some extent. The circuit is applied to an investigation of fast-neutron interactions in stilbene. For the case of 14.85-Mev neutrons it is shown that the majority of pulses of low light-output are due to α particles produced by neutron interactions with the carbon and that structure is apparent in this α-particle spectrum. Groups of α-particles due to the $C^{12}(n,\alpha)Be^{9}$ reaction and to the breakup of C^{12} from its excited states at 7.656 and 9.63 or 10.1 Mev are identified. (auth)

23619 DENSITY GRADIENT TECHNIQUES. Gerald Oster and Masahide Yamamoto (Polytechnic Inst. of Brooklyn). Chem. Rev., 63: 257-68(June 1963).

The most sensitive and simplest method for determining minute changes in density is the density gradient column technique, which is capable of detecting density differences as small as 10^{-7} g/cc. A review is presented of the theory and formation of the gradient, the movement of the test object in the gradient, and the applications of the technique. A bibliography of 99 references is included. (D.L.C.)

23620 RADIOACTIVE MEASUREMENTS OF THE DIAMETER OF LARGE-SIZE COMPONENTS. E. B. Milevskii. Dokl. L'vovsk. Politekhn. Inst., 5: 293-302 ([1962]).

Radioactive measurement of the diameter of large-size components may be carried out by determining either the gain in diameter or the absolute value of the latter. In the first case, one radiation source (RS) and one radiation detector are used. A narrow beam of parallel radiations passing through a collimator mounted on the RS, is sent tangentially to the surface of the component (part of the beam is covered by the component) and, after passing through another collimator, is received by a detector. The gain in diameter causes reduction or increase in the intensity of the radiation flux received by the detector; the intensity variations are recorded by an electronic computing device (system). However, vibrations of the component, particularly those of low frequency, increase the inertia of the measuring device, leading to reduction of its sensitivity accuracy, and speed of measurements. Large vibration amplitudes require a considerable increase in the beam width and hence particular attention to the geometrical shape of the RS. The scheme, two RS and two detectors, permits the measurement of the gain in diameter or its absolute value for components subjected to vibrations, movement, or displacement of the centerline. Both detectors are connected to a pulse-counting device that gives summation of readings. The readings vary with the changes in the component sizes, and are approximated by nonlinear curves. Despite some deficiencies, the method permits the recording of changes in the diameter caused by deposition of vapor, dust, and cooling liquid even for components subjected to vibrations. (TCO)

23621 A SIMPLE CIRCUIT FOR A REVERSIBLE DEKATRON COUNTER. S. Harigovindan (Indian Inst. of Science, Bangalore). Indian J. Pure Appl. Phys., 1: 42-4(Jan. 1963).

A simple circuit for a reversible dekatron counter requiring a single univibrator per stage is described. In this counter differentiation of a pair of push-pull rectangular pulses is used to obtain the properly sequenced pulses. The circuit effects an economy in components, requires only one voltage supply and can accept single-channel or two-channel inputs. (auth)

23622 A CIRCUIT FOR MEASUREMENT OF DECAY TIMES OF PHOSPHORS. S. B. Hyder and A. V. Rao (Osmania Univ., Hyderabad, India). Indian J. Pure Appl. Phys., 1: 85(Feb. 1963).

A circuit for the measurement of phosphorescence decay times of phosphors, employing the principle of a direct current counter chronograph and incorporating a simple gate circuit, is described. With this circuit decay times ranging from 10^{-2} to 10^{-5} sec can be recorded. (auth)

23623 THE PROPERTIES AND APPLICATIONS OF A GRID-CONTROLLED PHOTOMULTIPLIER. A. J. Walton (Univ. of Dublin). J. Electron. Control (1), 11: 341-59 (Nov. 1961). (In English)

A general description of a photomultiplier modified with a control grid is followed by an account of its static characteristics in which the dependence of the anode current on E.H.T. voltage, grid-cathode voltage, and the wavelength of the light source is described. Details are given of a method for achieving gain stability against changes in E.H.T. voltage by causing an increase in this voltage to reduce that between grid and cathode. The properties and applications of the tube when used to amplify a voltage signal applied to the grid are also discussed. It is shown that the effect of introducing d-c signal feedback between the anode and grid of the tube is to cause the anode current to vary logarithmically with light intensity, but that this relation is only very approximately true for a-c light sources. Proposals are made for simple coincident and anti-coincident counting circuits using the gating proper-

ties of the grid. A description is given of an instrument capable of determining the wavelength of a blue light source to within about 10 Å by using the variation of grid control with wavelength, and a possible method of analysing a multi-line spectra is suggested. Finally the question of what improvements would be desirable in any future grid-controlled photomultiplier is discussed, along with possible ways of obtaining them. (auth)

23624 DESIGN OF A GERMANIUM BENT-CRYSTAL DIFFRACTION MONOCHROMATOR & ITS APPLICATION IN NUCLEAR SPECTROSCOPY. E. J. Seppi, H. E. Henrikson, F. Boehm, and J. W. M. DuMond (California Inst. of Tech., Pasadena). J. Sci. Ind. Res. (India), 22: 29-43 (Jan. 1963).

A precision bent-crystal gamma-ray monochromator with stationary source has been built. The instrument consists of three independent units: the line source (a radioactive source or the anode of an x-ray tube), the 2-m-radius bent diffraction crystal with its pivot and sine-motion mechanism, and the heavy duty curved track framework which supports the collimator, detector, and shielding. The motions of the crystal pivot unit and of the detector carriage unit are linked together in such a way that the reflection condition is always satisfied. The precision of the monochromator for measurement of gamma-ray wavelengths is 0.003 X.U. The line width at half maximum, $\Delta\lambda$, observed when the (800) planes of a bent germanium crystal are used is 0.08 X.U. The resolution attained with the germanium crystal is illustrated by the unambiguous identification of the previously unobserved 245.237 kev gamma line, which was clearly resolved between the intense lines of 244.264 and 246.056 kev in the decay of W^{183}. Indicative experimental results obtained using the monochromator to observe nuclear resonance excitation in F^{19} and Mn^{55} are also given. (auth)

23625 INSTRUMENTATION FOR HIGH-ENERGY PHYSICS. Proceedings of the 1962 Conference held at CERN, Geneva, 16-18 July 1962. F. J. M. Farley, ed. Nucl. Instr. Methods, 20: 1-520(Jan. 1963).

One hundred and six papers and three summaries of papers are included under the following headings: new experimental techniques for use at ultrahigh energies and accelerator developments and improvements; machine developments and improvements; beam transport; bubble chambers; spark chambers; scintillation chambers; counter techniques; electronic circuitry; data analysis; high magnetic fields and new techniques. Separate abstracts were prepared for 89 papers. Seventeen were previously abstracted for NSA. (A.G.W.)

23626 EXPERIMENTAL TECHNIQUES AT ULTRA-HIGH ENERGIES. J. Sandweiss (Yale Univ., New Haven). Nucl. Instr. Methods, 20: 1-8(Jan. 1963). (In English)

Problems and techniques associated with the use of a proton synchrotron in the range 300 to 1000 Bev are discussed: (1) diffraction scattering in the 100-Bev range, (2) a study of high-energy neutrino interactions, and (3) a study of the properties of inelastic collisions in the 100-Bev range. In each case technical difficulties involved, extrapolation of current techniques, and possibilities for new instruments are surveyed. (A.G.W.)

23627 CURRENT DEVELOPMENT OF HIGH-ENERGY PROTON SYNCHROTRONS. H. G. Hereward (CERN, Geneva). Nucl. Instr. Methods, 20: 9-11(Jan. 1963). (In English)

Work planned and in progress is expected to result in the following improvements on existing accelerators: increased intensity from the region of 10^{11} protons per pulse to the region of 10^{12}; provision of extracted proton beams; better beam sharing techniques; and greater beam and target precision. (A.G.W.)

23628 A THREE-MAGNET EXTRACTION SYSTEM FOR THE 1 Gev ORSAY LINEAR ACCELERATOR. B. Milman (Faculté des Sciences, Orsay, France). Nucl. Instr. Methods, 20: 13-16(Jan. 1963). (In English)

The three-magnet extraction system consists of three identical magnets with normal entrance and exit, bending alternately right and left. The distances between the magnets are such that the center of each magnet is at the radial focus of the preceding one. A set of quadrupole lenses focuses the beam onto the target. Measurements to date indicate that the system behaves as predicted, notably with non-observable aberrations. (A.G.W.)

23629 FACTORS INFLUENCING THE STABILITY OF A SECONDARY ELECTRON MONITOR. D. B. Isabelle and P. H. Roy (Faculté des Sciences, Orsay, France). Nucl. Instr. Methods, 20: 17-20(Jan. 1963). (In English)

Secondary electron monitors built with ~10μ Al foils were unstable over long periods of time. Because the state of the surface was thought to be an important factor in this instability, 12μ Al foils were coated with 6μ electrolytic deposits of Ni on both sides and plated with 0.4μ of Au. These foils appear to give a much more stable efficiency over long periods of time. They can be used in the target chamber, even if it is necessary to open the chamber to air very often. The main disadvantage is that the foils have to be made by electrolytic deposit. (A.G.W.)

23630 ELECTROSTATIC SEPARATOR TECHNIQUE AT CERN. C. Germain and R. Tinguely (CERN, Geneva). Nucl. Instr. Methods, 20: 21-5(Jan. 1963). (In English)

Two large separator tanks have been successfully used in the proton synchrotron separated beams since Sept. 1961. The vacuum tank is a tube 1.4 m in diameter and 10 m long. The three pairs of polished stainless steel electrodes are so arranged that the spacing is adjustable up to about 25 cm. The uniformity of the electric field is 0.1% in the useful region. A pair of 600-kv SAMES generators provide the high-voltage supply. (A.G.W.)

23631 MASS SEPARATION BY MEANS OF MICROWAVE LINEAR ACCELERATION IN SECONDARY BEAMS. J. J. Murray (Univ. of California, Berkeley). Nucl. Instr. Methods, 20: 26-30(Jan. 1963). (In English)

The general features of a linearly separated beam are presented and merits of the method are pointed out. A linearly separated beam design emerging at the Lawrence Radiation Lab. in connection with plans for a 4 Bev/c K^- beam is considered specifically. (A.G.W.)

23632 CALCULATIONS OF A MAGNETIC FIELD MOMENTUM-DEFINING SLIT. E. L. Chu and J. Ballam (Stanford Univ., Calif.). Nucl. Instr. Methods, 20: 31-4 (Jan. 1963). (In English)

The configuration of a sharply defined magnetic field that might serve as a momentum-defining slit for very high intensity and high-energy electron beams is calculated. An idealized iron magnet slit is shown and the parameters for such a slit to be operated in the 25-Bev beam of the electron linear accelerator are given. (A.G.W.)

23633 A D.C. MAGNET POWER SUPPLY FOR 125 V, 500 A WITH CONTROLLED SILICON RECTIFIERS. A. Ašner and R. Mosig (CERN, Geneva). Nucl. Instr. Methods, 20: 35-6(Jan. 1963). (In English)

In the CERN 125-v, 500-amp standard power supply unit,

a double-Y rectification with an interphase reactor and six 100-amp Si rectifiers are used. Results of tests of the first prototype are given. The effects of ripples in the output voltage and in the current and the field of the powered magnet are discussed. It is concluded that in general no special filtering devices are necessary. (A.G.W.)

23634 PERFORMANCE OF THE AGS SEPARATED BEAM WITH HIGH-ENERGY KAONS. J. Leitner (Syracuse Univ., N. Y. and Brookhaven National Lab., Upton, N. Y.). Nucl. Instr. Methods, 20: 42-6(Jan. 1963). (In English)

A high-energy facility capable of producing separated beams of antiprotons and both positive and negative kaons has been constructed at the Brookhaven AGS. The expected and actually observed characteristics of the beam in connection with production of 2.3-Bev/c K^- are described. Transmission curves for 2.5-Bev/c K^- and 2.3-Bev/c K^+ are also shown. (A.G.W.)

23635 A ONE-STAGE SEPARATED K-MESON BEAM OF 1.5 Gev/c MOMENTUM AT THE CPS. G. Amato, H. Courant, H. Filthuth, E. Malamud, G. Petrucci, A. M. Segar, W. T. Toner, and W. Willis (CERN, Geneva). Nucl. Instr. Methods, 20: 47-50(Jan. 1963). (In English)

A one-stage separated beam 32.5 m long from target to mass slit is described. Characteristics of the beam are tabulated, and results of some counter flux measurements made in the beam from 0.8 to 2.0 Bev/c are shown. (A.G.W.)

23636 A COMPUTER PROGRAM TO OPTIMIZE MAGNETS IN A BEAM TRANSPORT SYSTEM. W. F. Baker (Brookhaven National Lab., Upton, N. Y.). Nucl. Instr. Methods, 20: 55-7(Jan. 1963). (In English)

A computer program that optimizes the locations and strengths of magnets in a beam transport system has been written for the IBM 704 and 7090 computers. In this program, the computer itself examines the characteristics of the emergent beam and varies the parameters of the system to optimize it. The linear theory is assumed in the program and beam separators are not included. The system has been used to prepare several experimental beams at the Cosmotron and the Brookhaven AGS. (A.G.W.)

23637 STATUS OF MAGNETIC HORN AND NEUTRINO BEAM. M. Giesch, B. Kuiper, B. Langeseth, S. van der Meer, D. Neet, G. Plass, G. Pluym, and B. De Raad (CERN, Geneva). Nucl. Instr. Methods, 20: 58-65(Jan. 1963). (In English)

The magnetic horn is a focusing device that accepts particles of widely varying momentum and with large emission angles. It is intended to focus π and K mesons coming from a target before they decay into neutrinos in order to produce a high-intensity neutrino beam. The proton beam from the CPS will be ejected and focused on an external target inside the horn. The ejection apparatus, transport channel, and horn are described. Curves show the estimated neutrino flux per circulating proton for different currents in the horn. (A.G.W.)

23638 DESIGN AND PERFORMANCE OF A SMALL-ANGLE, HIGH-INTENSITY SECONDARY PARTICLE BEAM FROM THE CERN PROTON SYNCHROTRON. M. Barbier, J. D. Dowell, P. I. P. Kalmus, B. Leontic, A. Lundby, R. Meunier, G. Petrucci, L. Solinas, J. P. Stroot, and M. Szeptycka (CERN, Geneva). Nucl. Instr. Methods, 20: 66-70(Jan. 1963). (In English)

Specialized beam transport arrangements that can be used at small angles without serious reduction in collection solid angle are described. The beam consists of two parts: the first comprises two special focusing and bending magnets that bend the particles 25° and focus them into a momentum-dispersed image 8m away from the target; the second part consists of standard CERN beam transport elements that produce an image with very good correction at 22m from the target. Curves show total observed beam intensities and particle ratios. (A.G.W.)

23639 THE HYDROGEN BUBBLE CHAMBER OF THE INSTITUTE OF THEORETICAL AND EXPERIMENTAL PHYSICS, MOSCOW. S. Ya. Nikitin (Inst. of Theoretical and Experimental Physics, Moscow). Nucl. Instr. Methods, 20: 95-9(Jan. 1963). (In English)

Two hydrogen bubble chambers are being built to be used with the beams of the 7-Bev proton accelerator. They have useful volumes of $55 \times 35 \times 35$ cm^3 and $205 \times 60 \times 45$ cm^3, respectively. Both chambers are described briefly, and vertical cross sections are shown. (A.G.W.)

23640 BROOKHAVEN NATIONAL LABORATORY 80" HYDROGEN BUBBLE CHAMBER STATUS AND PLANS. J. G. Androulakis, J. A. Bamberger, D. P. Brown, et al. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instr. Methods, 20: 100-9(Jan. 1963). (In English)

A hydrogen bubble chamber, 80" × 27" × 26", is under construction for use with the Brookhaven AGS. Unique features in its design include the following: a magnet yoke and vacuum chamber so integrated that the magnet coils can be supported without the usual heavy coil boxes; large stainless steel beam windows in both chamber and vacuum chamber; a piston fabricated of Inconel honeycomb; a temperature shield consisting of multilayers of aluminized Mylar sheets; an optical system designed to eliminate reflection from the main chamber window. The present status of the chamber is shown by a series of photographs, and future plans are described briefly. (A.G.W.)

23641 A 2-METRE PROPANE BUBBLE CHAMBER. M. P. Balandin, N. G. Borisov, Yung-chang Wang, R. P. Kukhareva, V. A. Moiseenko, V. I. Snyatkov, M. I. Solov'ev (Soloviev), and I. V. Chuvilo (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 110-13 (Jan. 1963). (In English)

A propane bubble chamber with a sensitive volume of $210 \times 65 \times 40$ cm^3 under construction at Dubna is described. It will operate in a constant magnetic field of 14 to 15 kG. The upper magnetic pole piece forms a part of the chamber construction. The expansion of the working liquid is directed downward. Illumination is provided through 26 holes with a separate lighting system for each hole. There are two photographic systems consisting of three cameras each. A special remote control table contains controls for each part of the system. (A.G.W.)

23642 A LIQUID HYDROGEN BUBBLE CHAMBER OF VOLUME $950 \times 350 \times 300$ mm^3. A. V. Belonogov, A. A. Belushkina, R. Vinaver, et al. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 114-15 (Jan. 1963). (In English)

A liquid hydrogen bubble chamber now under construction is described. It is intended for operation at the synchrophasotron in a nominal magnetic field of 15 kG. The chamber body is a steel casting with a neck welded to it to take the piston-type expansion mechanism. Synchronization of the chamber with the accelerator is achieved by means of a transistorized electronic control panel. (A.G.W.)

23643 HIGH-FIELD BUBBLE CHAMBER. W. H. Bergmann (Max-Planck-Institut für Physik, Munich), J. Gruber, G. Hahn, G. Harigel, P. Meyer, K. Moustafa,

and H. Roehm. Nucl. Instr. Methods, 20: 116-19(Jan. 1963). (In English)

A bubble chamber was built in the center of a condenser aggregate, which has a capacity of 1.85×10^{-3} f and can be charged nominally to 18 kv. The aggregate is subdivided into 60.5-kj units individually switched by a series and a crow-bar ignitron and connected each by two coaxial cables to the collector plate. A sectional drawing of the chamber is shown. The chamber was exposed to γ rays of up to 18 Mev at the Würzburg University 35-Mev betatron. An opaque spot in the center of some of the pictures is still unexplained. (A.G.W.)

23644 A PORTABLE 5 cm FREON BUBBLE CHAMBER FOR THE INVESTIGATION OF PARTICLE BEAM PROFILES. F. Bulos (Brown Univ., Providence), R. E. Lanou, Jr., I. A. Pless, and L. Rosenson. Nucl. Instr. Methods, 20: 125-7(Jan. 1963). (In English)

A freon bubble chamber weighing 100 lb and with overall dimensions of 18" × 18" × 7" is described. It was used successfully to investigate the cross sectional shape of a particle beam and to facilitate adjustment of the beam magnets to produce the desired shape. It could also be used to investigate the convergence or divergence of a beam. (A.G.W.)

23645 BUBBLE CHAMBER OPERATION IN THE REGIME OF AUTO-OSCILLATIONS. Yu. A. Budagov, V. P. Dzhelepov, V. G. Ivanov, Yu. F. Lomakin, V. B. Flyagin, and P. V. Shlyapnikov (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 128-32(Jan. 1963). (In English)

The possibility of constructing a high-efficiency bubble chamber is considered. The principle of operation depends on the production of pressure auto-oscillation conditions in the working fluid. A one-meter propane bubble chamber with a minimum air pressure stabilizer was used to study conditions for exciting and keeping up undamped oscillations in the chamber and conditions for bubble recompression. (A.G.W.)

23646 ULTRASONIC CAVITATION INDUCED BY NEUTRONS. B. Hahn and R. N. Peacock (Université, Fribourg, Switzerland). Nucl. Instr. Methods, 20: 133-4(Jan. 1963). (In English)

Liquid CCl_3F was excited ultrasonically in a cylindrical glass container by a magnetostrictive Ni-oscillator. When a Pu/Be neutron source approached, cavitation bubbles were immediately created and could be observed by eye or photographically. Depending on the magnitude of the external pressure the bubbles disappeared after several ultrasonic cycles or grew to large size and rose to the top of the container. This apparatus is a fast, continuously sensitive neutron detector, which is extremely insensitive to γ rays and to minimum ionizing particles. (A.G.W.)

23647 PARTICLE IDENTIFICATION FROM TRACK DENSITY FOR 4 Gev/c π-p REACTIONS IN THE 80 cm HYDROGEN BUBBLE CHAMBER. N. N. Biswas, I. Derado, K. Gottstein, V. P. Kenney, D. Lueers, G. Luetjens, and N. Schmitz (Max-Planck-Institut für Physik und Astrophysik, Munich). Nucl. Instr. Methods, 20: 135-9(Jan. 1963). (In English)

In analysis of π^--p collisions at 4 Bev/c in photographs taken at the CERN proton synchrotron, three types of information are available: (1) the kinematics of the event, (2) the density of the positive tracks, and (3) information from the scanning table. Results of a study of these three sources of information with regard to agreement between them, their efficiency, and their complementarity are summarized. For almost all the 74 2-prong events and 23 4-prong events studied, a definite decision could be made as to which reaction took place. Up to a momentum of ~2 Bev/c, track density measurement is an efficient tool for particle and event identification, agreeing with and supplementing the kinematic fit. Track density also permits events with several neutrals to be subdivided into two groups. If the kinematic fit accepts two or more hypotheses with reasonable χ^2, it is very dangerous to have a prejudice in favor of the hypothesis with the smallest χ^2. (A.G.W.)

23648 A DEVICE FOR THE DETERMINATION OF TRACK IONIZATION IN BUBBLE CHAMBERS. O. Balea, M. Batagui, A. Mihul, and C. Potoceanu (Inst. of Atomic Physics, Bucharest). Nucl. Instr. Methods, 20: 140(Jan. 1963). (In English)

An apparatus for measuring the integral distribution of gap lengths along a bubble chamber track is described. The film is placed on the stage of an Abbé comparator, which moves with constant velocity past a mark. An electronic system receives and records signals when the beginning and end of a gap pass through the mark. From the distribution thus obtained, an electronic computer calculates the relative track ionization. (A.G.W.)

23649 AUTOMATIC GAP COUNTING. G. Amato, W. A. Cooper, Y. Kornelis, and L. Naumann (CERN, Geneva). Nucl. Instr. Methods, 20: 141-2(Jan. 1963). (In English)

An almost fully automatic method for measuring mean gap lengths along bubble chamber tracks is described. The track image is produced by a projection microscope on a screen and moved at constant speed past a slit. The slit is scanned 300 times per second and pulses of different shapes are recorded by a photomultiplier to indicate whether the slit is lying across a bubble or across a gap. No results are yet available, but is is expected that a track of 3 cm can be measured in $1\frac{1}{2}$ min. Possible improvements in the apparatus are considered briefly. (A.G.W.)

23650 PRESENT STATUS OF SPARK CHAMBERS. J. W. Cronin (Princeton Univ., N. J.). Nucl. Instr. Methods, 20: 143-51(Jan. 1963). (In English)

Basic operation, construction techniques, and properties of spark chambers are reviewed. Experiments in which spark chambers have been used are listed, and several chambers now in use are described briefly. (A.G.W.)

23651 INFLUENCE OF GAS ADMIXTURES ON THE SENSITIVE TIME OF SPARK CHAMBERS. F. Schneider and K. H. Hoehne (CERN, Geneva). Nucl. Instr. Methods, 20: 152-5(Jan. 1963). (In English)

Some electronegative gases have an attachment probability for electrons, which is sensitive to the electron energy. In order to investigate the influence of this attachment process when the electronegative gas is present as an impurity, a three-plate spark chamber was constructed with stainless steel plates. Efficiency measurements were made in a pure Ar atmosphere and in different $Ar-O_2$ mixtures. It was found that the efficiency is strongly dependent on the partial pressure of O_2 and on the magnitude of the clearing field. Figures show the attachment probability as a function of electron energy for O_2 and the efficiency of the spark chamber as a function of clearing field and delay time. Contamination of Ar with N_2 was also found to enhance the electron drift velocity appreciably. (A.G.W.)

23652 USE OF RELATIVE IONIZATION FOR PARTICLE IDENTIFICATION IN MULTITRACK SPARK CHAMBER PICTURES. C. T. Coffin, L. J. Curtis, D. I. Meyer,

and K. M. Terwilliger (Univ. of Michigan, Ann Arbor). Nucl. Instr. Methods, 20: 156-60(Jan. 1963). (In English)

The design and operating conditions for a spark chamber used in a $\pi^- + p$ experiment at the Cosmotron are described briefly. Photographs are shown illustrating the considerable differences observed in spark densities of the four tracks of a given event. The relative track densities were compared with the particle velocities calculated from the reaction kinematics. An almost complete correlation was found; the lower-velocity particles were making the denser sparks. Effects other than ionization, which are important in determining spark density and must be taken into account in particle identification, are considered. (A.G.W.)

23653 SPARK CHAMBER EFFICIENCY FOR ELECTRON SHOWER DETECTION. H. Faissner, F. Ferrero, A. Ghani, F. Krienen, T. B. Novey, and M. Reinharz (CERN, Geneva). Nucl. Instr. Methods, 20: 161-4(Jan. 1963). (In English)

Aluminum and brass spark chambers were placed in an electron beam of momentum 2-10 Bev/c. Showers produced in a Pb converter of variable thickness located ~10 m in front of the spark chamber array were photographed. Efficiency measurements were made by defining particle tracks by some of the gaps and using them to test the behavior of the others. Results are shown for chambers filled with pure He and with a He–Ne mixture. It was concluded that there is no basic limitation on the number of relativistic particles that can be simultaneously observed in a spark chamber. (A.G.W.)

23654 THE SONIC SPARK CHAMBER AND SOME OF ITS EXPERIMENTAL ASPECTS. B. C. Maglić (Univ. of California, Berkeley). Nucl. Instr. Methods, 20: 165-7 (Jan. 1963). (In English)

Efforts to make spark chambers in which the sparks are located by sound are reviewed briefly. Advantages and limitations of this type of chamber are pointed out. (A.G.W.)

23655 A DIGITIZED SPARK CHAMBER. F. Krienen (CERN, Geneva). Nucl. Instr. Methods, 20: 168-70(Jan. 1963). (In English)

A wire spark detector is described, which is essentially a coordinate detector with a number of wire planes orientated in two planes. On each wire is threaded a magnetic core of the so-called square loop hysteresis type. A spark in the chamber results in a reversal of the magnetization in the corresponding core. The information concerning an event is stored in a number of switched cores, which can be read out in the usual way by threading additional wires through the cores. An efficiency >90% was measured in a model of the chamber. The spatial resolution was of the order of one wire spacing. (A.G.W.)

23656 A MAGNETIC SPECTROMETER USING SPARK CHAMBERS TO OBTAIN LARGE SOLID ANGLE AND HIGH RESOLUTION IN π-π INTERACTION STUDIES. D. Keefe, L. T. Kerth, C. M. Noble, J. J. Thresher, and W. A. Wenzel (Univ. of California, Berkeley). Nucl. Instr. Methods, 20: 171-2(Jan. 1963). (In English)

A system constructed to analyze final-state particles from $\pi^+ - p$ interactions at the Bevatron is described. The momentum of the incident π meson is determined by a spectrometer consisting of two small four-gap spark chambers followed by a deflecting magnet and another set of two spark chambers. The π mesons then interact in a liquid-hydrogen target. Two ten-gap spark chambers before and after the target are used to measure the incident and final-state particles. The particles then enter a large deflecting magnet and are finally detected in four large spark chambers extending 6 ft behind the deflecting magnet. (A.G.W.)

23657 MODULAR SPARK CHAMBERS. C. Rey and S. Parker (Univ. of Chicago). Nucl. Instr. Methods, 20: 173-5(Jan. 1963). (In English)

One-, two-, and four-gap spark chamber modules are constructed using 0.012 in. Al plates glued to lucite frames with gap dimensions of $\frac{1}{4} \times 21 \times 21$ in. Efficiencies >99% were obtained with no edge or satellite sparking and only occasional sparks at the gas holes. Techniques used in achieving these results are listed. An assembly of modules, scintillators, lead, and carbon used to search for $\mu^+ \rightarrow e^+ + \gamma$ is shown. (A.G.W.)

23658 MAGNETIC-FIELD SPARK CHAMBERS. G. K. O'Neill, F. V. Murphy, K. Wright, and D. Yount (Princeton Univ., N. J.). Nucl. Instr. Methods, 20: 176-9(Jan. 1963). (In English)

A 128-gap spark chamber was constructed with thin plates, 3-mm spacing, and a volume of $30 \times 30 \times 60$ cm. The chamber is operated in a 40-ton magnet designed for 18 kG. By adding about $\frac{1}{4}\%$ SO_2 to the neon filling, a clearing time was established in the chamber without a clearing field. (A.G.W.)

23659 A SIMPLE OPTICAL SYSTEM FOR USING STANDARD MAGNETS WITH SPARK CHAMBERS. K. Lande, A. K. Mann, and D. H. White (Univ. of Pennsylvania, Philadelphia). Nucl. Instr. Methods, 20: 193-4 (Jan. 1963). (In English)

A method is described for making use of a generally available standard bending magnet with a spark chamber without wasting much of the useful magnetic volume in the effort to provide stereoscopic viewing of the chamber. An optical system was designed, which consists essentially of replacing a plane mirror that would occupy a very large volume with a pair of effective echelon mirrors that occupy appreciably less volume. A diagram of the arrangement is shown. Tests to date were satisfactory. The cost was little more than the initial magnet cost. (A.G.W.)

23660 SPARK CHAMBER USE IN HIGH-ENERGY PHYSICS. V. S. Kaftanov and V. A. Lyubimov (Liubimov) (Inst. of Theoretical and Experimental Physics, Moscow). Nucl. Instr. Methods, 20: 195-7(Jan. 1963). (In English)

The following are described briefly: (1) 6-gap Al cylindrical spark chambers with 7-mm gaps used in a search for μ meson decays; (2) an arrangement of spark chambers and Cherenkov counters to be used in an experiment on π-p scattering with large momentum transfer; (3) a 40-gap spark chamber to be used in a measurement of μ-meson polarization in $K\mu_3$ decay. (A.G.W.)

23661 SPARK CHAMBERS WITH SMALL AMOUNT OF MATERIAL ALONG THE TRACKS. Yu. D. Bayukov, G. A. Leksin, D. A. Suchkov, and V. V. Telenkov (Inst. of Theoretical and Experimental Physics, Moscow). Nucl. Instr. Methods, 20: 198-200(Jan. 1963). (In English)

A spark chamber for detection of secondary mesons was constructed of 8 Al foils, each 7 μ thick, drawn on steel tambours and separated by a 1-cm gap. The chamber was placed in a container with polyethylene windows 70 μ thick. The amount of material in the way of particles was 8×10^{-3} radiation length. Curves show the efficiency in Ar and Ne. The effects of impurities in the Ar and Ne are discussed briefly. Data on the efficiency of detection of many particles in one gap are tabulated. (A.G.W.)

23662 THE APPEARANCE OF INCLINED DISCHARGE CHANNELS ALONG AN IONIZING PARTICLE TRACK.

G. Peter, A. A. Tyapkin, A. F. Pisarev, and Chu-Liang (Chu-lyang) Tzou (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 201-4(Jan. 1963). (In English)

The formation of discharge channels inclined to the field was investigated in a 2-gap spark chamber with various amplitudes of the high-voltage pulse and with different gas fillings of the chamber. It was shown that the limiting angle for the formation of a spark channel along the chain of electrons produced by ionizing particles increases with the increase of the high-voltage pulse amplitude. The largest limiting angle for the formation of an inclined streamer channel was observed when the chamber was filled with pure Ne and with Ne–0.5% Ar. When a particle traversed the chamber at an angle larger than 30°, distortions of the spark appeared at the electrodes. The cause of the distortions is considered. In a search for a gaseous mixture that could reduce the memory time, positive experimental data were obtained with the chamber filled with a mixture of 90.5% Ne, 0.4% Ar and 0.1% CH_4. (A.G.W.)

23663 THE APPLICATION OF THIN-PLATE SPARK CHAMBERS TO HIGH-ENERGY π-p EXPERIMENTS. E. Bleuler (CERN, Geneva), D. O. Caldwell, B. Elsner, D. Harting, L. W. Jones, W. C. Middelkoop, B. Zacharov, M. L. Perl, and C. C. Ting. Nucl. Instr. Methods, 20: 208-12(Jan. 1963). (In English)

Experiments on elastic pion-proton scattering and peripheral production of pions are described as illustrations of techniques involved in use of spark chambers. Features specifically pointed out include the following: use of thin-plate spark chambers spaced by some distance to sample two portions of a track in order to determine the angle of a track to a high precision; folding of the images of the several spark chambers and their stereoscopic views using a number of mirrors in order to present all the chamber data on a single 35-mm film frame; a method of aligning mirrors accurately based on the auto-collimation principle; a method of eliminating stereo ambiguity in cases where two tracks completely traverse a chamber without taking a third view. In general, use of spark chambers in these experiments corresponds to a sampling of particle trajectories in contrast to applications where an entire event is recorded as continuous tracks. (A.G.W.)

23664 THE CERN NEUTRINO SPARK CHAMBER. H. Faissner, F. Ferrero, A. Ghani, E. Heer, F. Krienen, G. Muratori, T. B. Novey, M. Reinharz, and R. A. Salmeron (CERN, Geneva). Nucl. Instr. Methods, 20: 213-19(Jan. 1963). (In English)

The design of the CERN neutrino spark chamber was mainly determined by the postulate of maximum flexibility. It consists of modular subunits that can be combined with counters and, if necessary, with absorbers in any suitable way. Some subunits are made of Al and some of brass. Each is the minimum practical size with two outside plates and one high-voltage leading plate in between. Problems presented by the optical system are discussed briefly. Possibilities and limitations of the chambers are illustrated by photographs taken in test runs on an assembly of 19 Al chambers followed by 4 brass chambers. (A.G.W.)

23665 HOMOGENEOUS SCINTILLATION CHAMBERS AND THE PHOTOGRAPHY OF CHERENKOV LIGHT. D. M. Binnie, M. Jane, J. A. Newth, D. C. Potter, and J. Walters (Imperial Coll. of Science and Tech., London). Nucl. Instr. Methods, 20: 221-5(Jan. 1963). (In English)

Experiments to view scintillation light and Cherenkov light were carried out at the Saclay proton synchrotron with two high-gain image intensifiers in cascade. Four materials were used in the homogeneous luminescent chamber: NaI, CsI, plastic scintillator, and a glass developed by the British Scientific Instrument Research Association. The probability (η) of recording a single photoelectron from the cathode of the first intensifier was estimated to be $0.25 < \eta < 0.5$. In the similar experiment on photography of Cherenkov light, η was found to be ~30%. Experiments were also performed to study beam profiles by end-on viewing of tracks in a sheet of plastic scintillator placed normal to the beam of particles. The fraction of particles recorded photographically was 70%. (A.G.W.)

23666 PHOTOELECTRON DETECTION EFFICIENCY OF HIGH-GAIN IMAGE INTENSIFIER SYSTEMS USED WITH SCINTILLATION CHAMBERS. G. T. Reynolds and J. R. Waters (Princeton Univ., N. J.). Nucl. Instr. Methods, 20: 226-8(Jan. 1963). (In English)

The method described for measurement of photoelectron detection efficiencies requires that a weak light source illuminate the photocathode of the first stage of the image intensifier system, and that the resulting electron current be measured. The light is then reduced by a known large factor so that the number of electrons emitted under these conditions is known. The number of electrons reaching the phosphor is attenuated by pulsing the tube. Photographs record the corresponding number of spots. Results of one series of measurements are shown. (A.G.W.)

23667 VARIABLE MAGNIFICATION OPERATION OF CASCADED IMAGE TUBES. B. Zacharov (CERN, Geneva). Nucl. Instr. Methods, 20: 229-32(Jan. 1963). (In English)

A method of operating a multistage image tube with electron-optical demagnification in the first stage is described. A demagnification ratio of about 2 : 1 appeared to be the greatest factor attainable with the present arrangement, but it is concluded that the ratio could be increased by more precise determination of the electric field. The demagnification can be made continuously variable over a considerable range. (A.G.W.)

23668 STATUS REPORT ON A LUMINESCENT CHAMBER. O. Gildemeister and R. Giese (Universität, Bonn). Nucl. Instr. Methods, 20: 233-5(Jan. 1963). (In English)

A magnetically focused 4-stage image intensifier was built for luminescent chamber experiments. Sandwich films consisting of phosphor screen, glass film, and photocathode surface were used. The image diameter of the tube is 3 cm. The light amplification is about 10^6. A homogeneous axial magnetic field of 1500 gauss was used, so that the electron helix-diameter defines the resolution independent of the applied voltage. The light spots produced by single photoelectrons have about 0.1 mm diameter. Tracks of cosmic-ray particles and 400-Mev positrons in CsI(Tl) were photographed with 1 : 1 imaging of the tracks on to the intensifier tube by means of two coupled f/1 lenses. (A.G.W.)

23669 MICROWAVE DISCHARGE CHAMBER. S. Fukui, S. Hayakawa, T. Tsukishima, and H. Nukushina (Nagoya Univ., Japan). Nucl. Instr. Methods, 20: 236-7(Jan. 1963). (In English)

Conditions for getting a good track of a cosmic-ray particle in a discharge chamber by using a pulsed microwave field are described. The microwave pulse generated by a magnetron traverses through a wave guide and is absorbed into a dummy load. As the sensitive volume, a glass tube filled with gas mixture is inserted into the wave guide. Uniformity of the electric field in the wave guide and addition of a small amount of alcohol to the gas mixture were found to be essential for good results. (A.G.W.)

23670 LIGHT CHAMBER OR GAS AMPLIFIED SCINTILLATION CHAMBER. C. Cavalleri, E. Gatti, and G. Redaelli (CISE, Milan). Nucl. Instr. Methods, 20: 238-41(Jan. 1963). (In English)

A light chamber was constructed of a pyrex glass cylinder with faces made of two pyrex glass discs. Operation is based on the decay of excited states caused by secondary electrons obtained by Townsend local multiplication of the primary electrons along the track. The multiplication is obtained through the application of a damped radiofrequency oscillation of electric field, given by a pulse generator triggered by a multiplier phototube sensitive to the primary scintillation. A photograph of tracks of α particles in the chamber is shown. Width of the tracks and causes of widening are discussed. (A.G.W.)

23671 A METHOD FOR MEASUREMENT OF CHARGED PARTICLE ELASTIC SCATTERING AT SMALL ANGLES. M. M. Butslov, M. N. Medvedev, and V. M. Sheshunov (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 242-4(Jan. 1963). (In English)

A system consisting of a filamentary scintillator, a scintillation counter, and an image intensifier is described. Two series of experiments were carried out to determine the suitability of the system for measurements of charged particle elastic scattering. Distances between the filamentary scintillator and the scintillation counter were 75 cm in the first and 150 cm in the second. The angular resolution of the device was 2.67×10^{-2} radian in the first and 1.34×10^{-2} radian in the second series of experiments. (A.G.W.)

23672 RANGE MEASUREMENT AND PARTICLE IDENTIFICATION IN A PLATE-LOADED FILAMENTARY CHAMBER. K. Lande, A. K. Mann, and D. H. White (Univ. of Pennsylvania, Philadelphia). Nucl. Instr. Methods, 20: 245(Jan. 1963). (In English)

A plate-loaded filamentary chamber consisting of 104 alternate layers of 1-mm dia plastic scintillator filaments and Au plates of approximately 1.5 g/cm^2 was used to measure the ranges and identify particles arising from the decay modes: $K^+ \rightarrow \pi^+ + \pi^0$ and $K^+ \rightarrow \pi^0 + \mu^+ + \nu$. Two range spectra were obtained: one including both muons and pions and one exhibiting almost exclusively particles recognized as π^+ from $K^+ \rightarrow \pi^+ + \pi^0$ by the mean life of their decay. (A.G.W.)

23673 RECENT ADVANCES IN COUNTER TECHNIQUES. V. L. Fitch (Princeton Univ., N. J.). Nucl. Instr. Methods, 20: 247-55(Jan. 1963). (In English)

Developments in counter techniques since Sept. 1960 are reviewed. Cherenkov, scintillation, and solid-state detectors are considered. (A.G.W.)

23674 FOCUSING GASEOUS CHERENKOV COUNTERS FOR PARTICLE IDENTIFICATION AT THE BROOKHAVEN AGS. S. J. Lindenbaum, W. Love, S. Ozaki, J. Russell, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). Nucl. Instr. Methods, 20: 256-60(Jan. 1963). (In English)

Two gaseous Cherenkov counters used at Brookhaven are described, and schematic diagrams of both are shown. One is a small (9 in. long) lens type focusing counter originally designed and used for Cosmotron K^+ production experiments. The second is a much higher resolution cylindrical mirror counter, which was used for most of the high momentum particle separation work at the AGS. Typical CO_2 pressure curves for both counters show successive pion, kaon, and antiproton peaks as the pressure is increased. (A.G.W.)

23675 ANGULAR GAS CHERENKOV COUNTER. M. F. Likhachev (Likhatchev) and V. S. Stavinskii (Stavinsky) (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 261-2(Jan. 1963). (In English)

The angular gas Cherenkov counter described was intended for selection and registration of π and K mesons and protons. The spherical mirror has a focal length of 1100 mm. The phototubes are placed at the foci of the two parabolic mirrors. The working gas is ethylene. The angular resolution is ±26′. (A.G.W.)

23676 CHERENKOV RINGS FROM SINGLE PARTICLES OBSERVED WITH A HIGH-GAIN IMAGE INTENSIFIER SYSTEM. G. T. Reynolds, J. R. Waters, and S. K. Poultney (Princeton Univ., N. J.). Nucl. Instr. Methods, 20: 267-70(Jan. 1963). (In English)

A high-gain image intensifier system with a lucite Cherenkov radiator was used in an attempt to detect photons in Cherenkov rings. The radiator was a cone of half-angle 19° with an effective path length of 4.8 cm. The particles used emitted light in a cone of half-angle 47°13′, which was transformed to 14° by one internal reflection. On the average five spots were seen on the ring from individual particles. It appears that Cherenkov light has been observed, but that the rings cannot yet be used for precision measurements because of the small number of spots and poor resolution. (A.G.W.)

23677 EFFECT OF CHERENKOV LIGHT POLARIZATION ON TOTAL REFLECTION COUNTER. J. D. Dowell, P. Duteil, B. Leontic, A. Lundby, R. Meunier, J. P. Stroot, and M. Szeptycka (CERN, Geneva). Nucl. Instr. Methods, 20: 271-5(Jan. 1963). (In English)

A rugged total internal reflection counter with a 3- to 5-cm thick compact radiator was used at the CERN proton synchrotron for beam analysis. The threshold behavior of this counter was compared when filled with glycerol and with turpentine. Turpentine is optically active and rotates the plane of polarization about 7°/cm. Figures illustrate the effect of this polarization rotation. (A.G.W.)

23678 ON A POSSIBLE METHOD OF REGISTRATION OF HIGH-ENERGY NEUTRINOS. A. I. Alikhanyan, E. M. (U.) Laziev, and V. (W.) A. Tumanyan (Physical Inst., Erevan, USSR). Nucl. Instr. Methods, 20: 276(Jan. 1963). (In English)

The method suggested for registration of neutrinos with energy above 100 Bev is based on the possibility of detecting the Cherenkov radiation from electron cascade produced by the interaction of high-energy neutrinos in dense matter. It is estimated that the signal amplitude at 100 m from the origin of the cascade will exceed by two orders of magnitude the noise level of modern detectors. (A.G.W.)

23679 SYSTEM FOR THE REGISTRATION OF PARTICLE ENTRANCE COORDINATES FOR AN EMULSION CHAMBER. A. S. Dvoretskii (Dvoretski), V. A. Kazakov, I. V. Kolesov, Yu. Oravets, I. I. Skryl (Skril), V. F. Sikodenko (Sikolenko), L. V. Silvestrov, N. S. Frolov, and M. S. Khvastunov (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 277-81(Jan. 1963). (In English)

A spark counter telescope placed in front of the emulsion chamber permits definition of the coordinates of particle entrance into the emulsion. The spark counters can be triggered from instruments singling out particles with set characteristics. Photographs of the discharge in the counter are measured with a microscope and spark coordinates in space are calculated. The emulsion region near

the supposed spot of particle entrance is scanned. In preliminary data coordinates of tracks found differed from coordinates of tracks calculated by not more than ±0.5 mm. Counter characteristics with various fillings are discussed. (A.G.W.)

23680 PERFORMANCE OF LARGE LIQUID SCINTILLATION COUNTERS. H. Faissner, F. Ferrero, A. Ghani, and M. Reinharz (CERN, Geneva). Nucl. Instr. Methods, 20: 289-93(Jan. 1963). (In English)

In a systematic study of the performance of large scintillators, a container in the form of a rectangular parallelepiped with the larger surface ~2 m^2 and with a thickness for the liquid of 14 cm was used. The counter was placed between two telescope counters of 10 × 10 cm^2 in a beam of relativistic mesons. The counter pulses were displayed on a kicksorter gated by a coincidence between the telescope counters. Uniformity curves were obtained by moving the counter. The following factors are considered: (1) fraction of container surface covered with photocathode, (2) reflectivity of the container surface, (3) absorption length of scintillation liquids, and (4) geometry of the photomultiplier arrangement. (A.G.W.)

23681 PROPERTIES OF A TOTAL ABSORPTION SCINTILLATION DETECTOR FOR PARTICLES IN THE Gev REGION. G. Backenstoss, B. D. Hyams, G. Knop, and U. Stierlin (CERN, Geneva). Nucl. Instr. Methods, 20: 294-6(Jan. 1963). (In English)

The detector was made of 20 scintillation sheets, 1 cm thick and 40 × 30 cm^2. Between the scintillator sheets, Pb plates of variable thickness could be inserted. In the measurements taken the total thickness of the 20 Pb plates amounted to 8, 12, and 16 radiation lengths (λ_r) in 3 different arrangements. The energy response and resolution of the detector were studied for incident electron energies of 1 to 10 Bev. The response was linear up to 10 Bev with 16 λ_r. Linearity was lost at 8 Bev with 12 λ_r and near 3 Bev with 8 λ_r. The best resolution was obtained with 12 λ_r. Curves show the response of the detector to μ mesons, π mesons, and electrons of 7 Bev. (A.G.W.)

23682 A COUNTER HODOSCOPE SYSTEM WITH DIGITAL DATA HANDLER AND ON-LINE COMPUTER FOR ELASTIC SCATTERING AND OTHER EXPERIMENTS AT BROOKHAVEN AGS. S. J. Lindenbaum (Brookhaven National Lab., Upton, N. Y.). Nucl. Instr. Methods, 20: 297-302(Jan. 1963). (In English)

A two-dimensional 12 × 12 counter hodoscope array composed of 30 × 2½ × ½ in. plastic scintillation counters is described. An example of the use of a hodoscope system in high-energy elastic scattering is shown. A Cherenkov telescope selects the desired particles from the beam. Two hodoscope arrays fix the direction of the forward-scattered particle. A magnet followed by another hodoscope array determines the particles' momentum. The recoil proton is detected by two more hodoscope arrays. The data are recorded rapidly by a 96-channel digital data handler. A magnetic tape transport operates in parallel with a direct data input to the computer system. The computer can almost immediately provide printed out data and curves. Alternatively, the tape can be used to feed the computer either during the experiment if the on-line fails temporarily or later for more complicated analyses. (A.G.W.)

23683 INVESTIGATIONS ON LITHIUM-DRIFT SOLID-STATE DETECTORS FOR HIGH-ENERGY PARTICLE DETECTION. G. L. Miller, S. Wagner, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). Nucl. Instr. Methods, 20: 303-5(Jan. 1963). (In English)

Lithium-drift solid-state detectors with depletion layers of several millimeters were developed. A lithium-drift detector, 1 cm in diameter and 2.3 mm thick, was placed in a momentum-analyzed beam consisting of pions and protons with momerta of 3 and 4 Bev/c. Energy spectra at different bias voltages are shown. Good resolution was obtained operating at room temperature. (A.G.W.)

23684 ELECTRONIC INSTRUMENTATION FOR RESEARCH IN ELEMENTARY PARTICLE PHYSICS AND COSMIC RAYS AT HONG KONG. C. P. Wang (Univ. of Hong Kong, China). Nucl. Instr. Methods, 20: 306-7(Jan. 1963). (In English)

Work being carried out at the University of Hong Kong on the following is summarized briefly: (1) design and construction of a 50-channel pulse height analyzer, (2) design and construction of the electronic gear for the study of double β decay, (3) construction of a composite 5-tray cosmic-ray counter telescope and the associated electronic system, and (4) design of electronic gear for the study of extensive air showers. (A.G.W.)

23685 TUNNEL-DIODES IN FAST CIRCUITS. E. Baldinger (Universität, Basel). Nucl. Instr. Methods, 20: 309-12(Jan. 1963). (In English)

A simple test circuit for the determination of tunnel diode parameters is described. Diagrams are shown of a scale-of-4 with a resolution of 200 Mc and a scale-of-5 with medium speed and low power consumption. Both scalers use Ge-tunnel diodes. The positive feedback inherent to tunnel diode amplifiers is discussed. (A.G.W.)

23686 A 100 Mc/s DISCRIMINATOR AND SCALER. H. Verweij (CERN, Geneva). Nucl. Instr. Methods, 20: 323-9(Jan. 1963). (In English)

The discriminator and scaler described are capable of handling up to 4 × 10^6 pulses per machine burst of 200 msec length and scaling up to 5 pulses in a period of about 50 nsec. Primarily the instrument is a scaler, and by equalizing the sensitivity of the two states of the first bistable discriminator action is obtained. The bistables are made with transistors rather than tunnel diodes. The scaler consists of three cascaded binary stages. Circuit diagrams of the threshold amplifier and scaler are shown. Curves show the resolving time, threshold vs input pulse, and threshold vs temperature. In use at the CERN proton synchrotron, these instruments performed reliably over long periods. (A.G.W.)

23687 25 Mc/s SCALERS WITH FLEXIBLE PRINT-PUNCH FACILITIES. F. Iselin (CERN, Geneva). Nucl. Instr. Methods, 20: 330-5(Jan. 1963). (In English)

A transistor 25-Mc six decade scaler and a flexible print-punch system that will handle up to 30 scalers are described, and a block diagram of the whole system is shown. The scaler is a plug-in unit to use in a CERN standard crate. Up to four scalers can be used with one power supply. The print-punch facilities can provide printing or punching separately or simultaneously. The system was designed for use in counter experiments with particle accelerators. It has performed correctly and reliably at CERN. (A.G.W.)

23688 INVESTIGATION OF THE Q OF A SUPERCONDUCTING MICROWAVE CAVITY. P. B. Wilson (Stanford Univ., Calif.). Nucl. Instr. Methods, 20: 336-40(Jan. 1963). (In English)

The cavity, constructed of Cu with a surface deposit of the superconductor being tested, was fastened directly to

the bottom of a liquid He reservoir. It was about 14 cm in diameter, 14 cm in length, and was resonant at 2856 Mc in the TE_{011} mode. An important feature was a variable coupling mechanism consisting of a closed wire loop suspended by a moveable dielectric arm, which extends into the cavity through a small hole in the cavity end plate. The Q of the cavity was measured by the decrement method. Measurements were made on an unpolished electroplated lead surface and on several types of tin surfaces. A curve shows variation of cavity Q with temperature. A table shows values of surface resistivity obtained. (A.G.W.)

23689 A FAST LINEAR GATE. J. B. Lindsay (CERN, Geneva). Nucl. Instr. Methods, 20: 345-51(Jan. 1963). (In English)

The instrument described was designed to operate as a linear gate for fast scintillation counter pulses thereby allowing events to be selected at a suitable rate. After gating, the fast signal is integrated and shaped on a passive network that gives a pulse shape acceptable for the input of commercially available multichannel pulse-height analyzers. An internal paralysis is provided to the gate opening so that each slow output signal will be completely over before a second input signal can reach the integrating and shaping network. A circuit diagram, a linearity curve, and a gate shape curve are shown. (A.G.W.)

23690 NANOSECOND AVALANCHE TRANSISTOR CIRCUITS. E. Gygi and F. Schneider (CERN, Geneva). Nucl. Instr. Methods, 20: 352-4(Jan. 1963). (In English)

The technique of producing narrow pulses with the help of avalanche transistors described previously by others was applied to the design of delay-line oscillators and fast coincidence circuits. Diagrams of the instruments are shown, and their performance is discussed briefly. (A.G.W.)

23691 A NEW ENCODER. A. Alberigi-Quaranta and B. Righini (Università, Bologna). Nucl. Instr. Methods, 20: 355-7(Jan. 1963). (In English)

The encoder described is to be used in a compact pulse analyzer characterized by a low channel number and a short dead and operation time. The circuit operates as follows: the voltage pulse to be analyzed is fed to a closed loop where the pulse begins to circulate. The loop is formed by a delay line, a fast linear amplifier, and a diode inversely biased at a regulable voltage. The delay line determines the pulse circulation time, the amplifier compensates for the pulse amplitude losses in the loop, and the biased diode subtracts a constant voltage from the pulse for every turn that the pulse makes in the loop. A complete diagram of the encoder and a typical pulse train obtained are shown. (A.G.W.)

23692 A FAST PULSE ENCODER. H. I. Pizer (CERN, Geneva). Nucl. Instr. Methods, 20: 358-61(Jan. 1963). (In English)

The principle of the encoder described consists of exciting oscillations in a Hartley oscillator adjusted to be just critical such that its amplitude of oscillation is proportional to the size of the exciting pulse. A diode circuit attached to the tuned circuit is arranged to remove a constant charge from the tuned circuit each cycle thereby reducing the oscillation amplitude by equal increments each cycle. The total number of increments is then proportional to the initial amplitude. The linearity control and discriminator level can be set by plotting the number of pulses versus input amplitude. It has been possible to encode more than 200 pulses linearly, but the stability at this level is not certain and a maximum level of 50 pulses is recommended. (A.G.W.)

23693 TRANSISTORIZED ANALOG-TO-DIGITAL CONVERTER FOR NUCLEAR SPECTROMETRY. C. Bonsignori, D. Malosti, and U. Pellegrini (Laben, Laboratori Elettronici e Nucleari, Milan). Nucl. Instr. Methods, 20: 362-6(Jan. 1963). (In English)

The instrument described is an "amplitude-to-time" type converter, completely transistorized, in which a capacitor is charged to the peak of an incoming pulse. The linear discharge time of the capacitor, proportional to the peak amplitude, is measured by a gated quartz oscillator and the resulting number of gated pulses is the digital information of the pulse height. Tests indicate that a differential linearity better than ±2% is reached above channel 8, not exceeding ±1% above channel 10. A drift of about 0.5% due to all causes was observed. This converter, with a minimum channel width of 10 mv and an input dynamic range from 0.5 to 15 v, allows an analysis with an equivalent number of channels of about 1500. (A.G.W.)

23694 THE DEVELOPMENT OF DATA ANALYSIS SYSTEMS FOR BUBBLE CHAMBERS, FOR SPARK CHAMBERS AND FOR COUNTER EXPERIMENTS. G. R. Macleod (Università, Pisa, Italy). Nucl. Instr. Methods, 20: 367-83 (Jan. 1963). (In English)

Work done on bubble chamber data processing methods in the past two years is reviewed. It includes improvements to the now standard methods, development of new measuring devices, and progress on completely automatic systems. Most projects for automatic processing of spark chamber pictures take the most recent bubble chamber analysis techniques as their starting point, but several methods to determine spark positions without the use of film are reviewed in relation to their possible use in an automatic data analysis system. Development of data processing methods for counter experiments has shown two main features since 1960: (1) construction and use of a variety of digital data-handling systems, and (2) use of digital computers on-line to control data flow, to do a certain amount of processing during an experiment, and to carry out checks on the operation of the equipment. (A.G.W.)

23695 DEVELOPMENT OF A BUBBLE CHAMBER DATA ANALYSIS USING SEVERAL SCANNING-MEASURING-PROJECTORS ON-LINE TO A DIGITAL COMPUTER. R. I. Hulsizer (Univ. of California, Berkeley). Nucl. Instr. Methods, 20: 384-6(Jan. 1963). (In English)

A prototype scanning measuring projector was constructed and connected to the direct data channel of an IBM 709 computer. The first set of tests made consisted in measuring straight wires stretched over the surface of the image plane. A preliminary version of a program for measuring actual bubble chamber tracks was written and a few tracks were measured. A smooth curve through measured points was determined to an accuracy of 2 μ in the film plane. Programs for carrying out the ingestion of data and the on-line analysis are being developed. Calculations indicate that the 709 could do a fairly thorough analysis of the output from 3 to 8 on-line scanning-measuring projectors. (A.G.W.)

23696 REALISATION OF HPD SYSTEMS AT THREE LABORATORIES. J. V. Franck (Univ. of California, Berkeley), P. V. C. Hough, and B. W. Powell. Nucl. Instr. Methods, 20: 387-92(Jan. 1963). (In English)

The basic feature of the HPD system is the use of a spot of light to execute a regular rectangular scan over the whole bubble chamber picture. Individual bubbles are digitized to an accuracy of about ±3 μ. These digitizings are transmitted directly to an on-line general purpose digital computer. Production versions of this machine were built

and are beginning to operate at CERN, Brookhaven, and Berkeley. The three machines are based on the same principles but have different layouts and accordingly have different advantages and inconveniences. Special scanning tables are being developed, and steps are being taken to incorporate ionization density measurements into the program. (A.G.W.)

23697 DESIGN OF A PATTERN RECOGNITION DIGITAL COMPUTER WITH APPLICATION TO THE AUTOMATIC SCANNING OF BUBBLE CHAMBER NEGATIVES. B. H. McCormick and R. Narasimhan (Univ. of Illinois, Urbana). Nucl. Instr. Methods, 20: 401-6(Jan. 1963). (In English)

The overall computer system contains three main parts: an input device, a pattern recognition unit (PRU), and a control computer. The bubble chamber picture is divided into a grid of ~1-mm squares on the film. It is then processed in parallel in a two-dimensional array of 1024 identical processing modules (stalactites) of the PRU. The array can function as a two-dimensional shift register in which results of successive shifting operations can be accumulated. The pattern recognition process is generally controlled by a conventional arithmetic computer. (A.G.W.)

23698 SCANNING PATTERNS FOR AUTOMATIC TRACK AND EVENT RECOGNITION. D. Maeder (CERN, Geneva). Nucl. Instr. Methods, 20: 407-12(Jan. 1963). (In English)

The difficulties of constructing a high-resolution fast programable access (FPA) scanner and the possible use of analog techniques in performing the basic operations of track recognition are discussed. Methods for programable CRT spot positioning, a universal FPA scanner using optical multiplication, and a restricted FPA scanner using differential deflection are considered. A star pattern scanner intended for scanning a small section of the total field at constant velocity along straight lines in many different directions in each revolution is described. (A.G.W.)

23699 A PRELIMINARY STUDY OF A CATHODE-RAY TUBE DEVICE FOR SCANNING SPARK CHAMBER PHOTOGRAPHS. H. Anders, D. Maeder, and D. Wiskott (CERN, Geneva). Nucl. Instr. Methods, 20: 414-18(Jan. 1963). (In English)

The scanner described follows the principles of the Hough-Powell digitizer, but a cathode ray tube is used as flying spot generator. Direction of scan can be 0° or 90°, number of lines can be 100 to 800, and scan time per line is 750 μsec. Digitizing along the scan lines is done by starting an oscillator at the well-defined edge of the picture and counting its oscillations. In the perpendicular direction, the number of the scan lines will be used. The device will be calibrated at regular intervals by scanning a test pattern. Stability has been found to be better than 0.1% over periods of 30 sec. (A.G.W.)

23700 A TRACE FOLLOWING DEVICE. J. Richez (CERN, Geneva). Nucl. Instr. Methods, 20: 419-21(Jan. 1963). (In English)

A circuit that makes the spot of a cathode ray tube follow a black line recorded on film is described. An image of the spot is projected on the surface of the film to be analyzed. A photomultiplier behind the film collects the light of the spot passing through the film and gives a signal each time the spot is hidden by a black trace on the film. Photographs of results are shown. The part of the instrument that will record the values of the coordinates on a printer or punch is being developed. A method of applying the instrument to analysis of spark chamber pictures is proposed. (A.G.W.)

23701 AN IBM PROGRAM FOR THE KINEMATICAL ANALYSIS OF COMPLETE TRACK CHAMBER EVENTS. R. Boeck (CERN, Geneva). Nucl. Instr. Methods, 20: 435-6(Jan. 1963). (In English)

A program for the kinematical analysis of complete track chamber events was written at CERN and named GRIND. It forms the second link of the standard analysis chain, being preceded by a program for geometrical reconstruction and followed by a statistical analysis program. It is based on two major principles: Flexibility and the least squares method. The logical flow of a typical program is as follows: (1) reading of the general data, (2) preparation of data for kinematical analysis, (3) single-point analysis, (4) mass assignments and classification of interaction types, and (5) fitting of several vertices together when applicable. (A.G.W.)

23702 A DEVICE FOR AUTOMATIC MEASUREMENT OF CHAMBER PHOTOGRAPHS APS-1M. V. Ya. Almazov, I. A. Golutvin, V. D. Inkin, Yu. A. Karzhavin, V. D. Neustroev, V. D. Stepanov, and I. V. Chuvilo (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 437-41(Jan. 1963). (In English)

The APS-1M is a precision device for the automatic measurement of charged particle track coordinates on photographs taken from bubble chambers. It is designed to punch certain coordinates and other data on tape for subsequent processing in an electronic computer. It consists of a single unit with paper tape output and a keyboard for the input of control information. The maximum velocity of tracking is 4 mm/sec. Root mean square error of the measurement of points along tracks in the automatic tracking mode does not exceed 3 μ. A choice of automatic or hand tracking is possible. (A.G.W.)

23703 A METHOD AND DEVICE FOR AUTOMATIC SCANNING OF NUCLEAR EMULSIONS. Yu. A. Bichkov (Bychkov), Vi Chun Von, A. M. Frolov, E. Katz, T. Pacuraru, V. A. Petukhov, O. M. Tsislyak, and V. Ya. Volkov (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instr. Methods, 20: 442-5(Jan. 1963). (In English)

The proposed method of automatic scanning of emulsions exposed to a beam of charged particles allows rapid automatic location of events. The emulsion is scanned by an optical-mechanical scanning unit. The information from several consecutive layers is accumulated in an analog memory device, and the accumulated information is processed by a logical analysis system. When the criterion used to define an event is satisfied, the logical analysis system gives a signal and coordinates of the event are recorded automatically. Calculations show that scanning speed could reach at least 50 m of primary track per hour and that an angular resolution of about 0.25° may be reached. (A.G.W.)

23704 ELECTRON AND π^0 MEASUREMENTS IN A HEAVY LIQUID BUBBLE CHAMBER. L. Behr and P. Mittner (Ecole Polytechnique, Paris). Nucl. Instr. Methods, 20: 446-7(Jan. 1963). (In English)

A method is described for determining the energy of electrons by curvature, based on simple trajectory parameters, the total length and the sagitta (measured at the middle point). The effect of bremsstrahlung on sagitta measurement is analyzed. Measurement of the momentum and mass of a π^0 is discussed briefly. (A.G.W.)

23705 AN APPROXIMATE METHOD OF CORRECTING FOR NON-UNIFORMITY OF MAGNETIC FIELD AND ENERGY LOSS OF PARTICLES IN A HYDROGEN BUBBLE

CHAMBER. C. J. B. Hawkins (Oxford Univ.). Nucl. Instr. Methods, 20: 455-7(Jan. 1963). (In English)

The path of a charged particle in a bubble chamber with a magnetic field deviates from a perfect helix because of multiple scattering, energy loss, and variation of the field along the track. The last two are systematic and can be corrected for. The method described for making the correction is based on the track projected onto a plane rather than the track in space. It considers the deviation of curvature rather than of space points. The correction technique was tested in measuring the K° mass. Results are shown. (A.G.W.)

23706 A METHOD FOR THE SPATIAL RECONSTRUCTION OF BUBBLE CHAMBER TRACKS. R. J. Plano (Rutgers Univ., New Brunswick, N. J.) and D. H. Tycko. Nucl. Instr. Methods, 20: 458-60(Jan. 1963). (In English)

A spatial reconstruction method for bubble chamber tracks is described, which requires a minimum number of measurements, involves a relatively simple computation, and yields results of a precision comparable to those obtained by more complex methods. The method is based on the fact that the properties of a track in a bubble chamber can be determined quite accurately from knowledge of the coordinates of three points on the track. The three space points are used to determine the parameters of a helix. Corrections can be made for the effects of magnetic field variations and energy loss. (A.G.W.)

23707 THE USE OF A FLYING LINE FOR AUTOMATIC SCANNING OF BUBBLE CHAMBER PHOTOGRAPHS. J. W. Burren (Rutherford High Energy Lab., Harwell, Berks, Eng.) and W. A. Woodley. Nucl. Instr. Methods, 20: 461-3(Jan. 1963). (In English)

The device suggested is similar to the flying spot digitizer of Hough and Powell, but it would give information in a condensed form more suitable for automatic scanning. A line segment of light 1 mm long by 20-25 μ wide would be swept across the film at 30 different angles from –45° to +45° about a direction normal to the direction of scan. The film would be moved on a stage in a direction perpendicular to the scan so that it would have moved on 1 mm in the time of the 30 different angle scans. Experiments needed to establish the feasibility of the device are listed. Results of a preliminary attempt at scanning film are shown. (A.G.W.)

23708 EXPERIMENTAL UTILIZATION OF PROTON STORAGE RINGS. L. W. Jones and B. De Raad (CERN, Geneva). Nucl. Instr. Methods, 20: 477-81(Jan. 1963). (In English)

The addition of 25-Bev proton storage rings to the CERN proton synchrotron for possible use in experiments with colliding beams was studied. Possible storage ring parameters are summarized. The layout of the interaction region and the magnets required are discussed. Detectors for possible use with colliding beams are considered, and a possible arrangement of spark chambers around the interaction region is shown. (A.G.W.)

23709 A TRIGGERED LIQUID TRACK CHAMBER WITH SHORT RESOLVING TIME. G. Charpak (CERN, Geneva). Nucl. Instr. Methods, 20: 482-6(Jan. 1963). (In English)

The principle of a new type of track detector is described. Bubbles of gas are produced in oil by injection through a porous surface at the bottom of an oil container with transparent walls. An electric field can be applied to the liquid by means of plane electrodes. When a charged particle, detected by scintillation counters, traverses the liquid between the electrodes, the voltage is applied to the liquid. Those bubbles ionized by the particle give rise to a discharge limited to the bubble so that all the track is made visible. With neon bubbles of about 2 mm in paraffin oil, tracks are visible at several meters from the chamber and easy to photograph. The applied field ranges from a few kv/cm to 30 kv/cm. (A.G.W.)

23710 A 150 kG TRANSVERSE FIELD PULSED MAGNET. Ph. Rosselet (Université, Lausanne, Switzerland). Nucl. Instr. Methods, 20: 487-8(Jan. 1963). (In English)

A special type of coil was designed and built to give a uniform transverse field of 150 kG over a length of 20 cm, in a useful volume of about 500 cm^3. The coil consists of 20 rectangular plates of Cu–1% Cr split and Ag-soldered in series to form a helix. It is divided into two halves to provide space for a beam hole. Vetronite (glass fiber impregnated with epoxy resin) is used as insulation. The coil is cooled with demineralized water circulating inside the central ring and between the Cu and a plastic box that can contain photographic emulsions. A coil now being constructed on the same principle is expected to work safely at 150 kG for several thousand pulses. (A.G.W.)

23711 A 200 kG PULSED MAGNET FOR EMULSION EXPERIMENTS. L. Hoffmann and M. Morpurgo (CERN, Geneva). Nucl. Instr. Methods, 20: 489-93(Jan. 1963). (In English)

Types of experiments involving the application of high fields in connection with the emulsion technique are listed, and the main requirements of the field are summarized. Coils used in a test run were made from disks of Cu-1% Cr soldered together to form a helix and insulated with vetronite (glass fiber impregnated with epoxy resin). The lifetime of this coil was on the order of 3000 pulses for fields of 200 kG. To reach longer lifetimes and possibly higher fields, two other types of coil are being developed: (1) aluminum coils with insulation of aluminum oxide and (2) flux concentrator coils of various types. (A.G.W.)

23712 DEVELOPMENTS IN SUPERCONDUCTOR SOLENOIDS. R. W. Boom, L. D. Roberts, and R. S. Livingston (Oak Ridge National Lab., Tenn.). Nucl. Instr. Methods, 20: 495-502(Jan. 1963). (In English)

Two of the major problems foreseen in the design of large superconducting solenoids were studied: (1) field collapse and (2) the achievement of usable current densities. Four model magnets were fabricated from 0.010-in. Nb-25 at. % Zr and tested at liquid He temperatures. It was shown that a Cu secondary circuit effectively absorbs a major portion of the field energy and protects the NbZr from both excessive heating and from high voltages generated during field collapse. At least two methods of magnet construction showed promise of increasing current densities: (1) use of Cu- or Inconel-covered NbZr, and (2) use of the Cu secondary with the magnet cast in epoxy. A preliminary design for a 12-in. ID split solenoid with Cu secondary suitable for a bubble chamber is described briefly, and field plots for it are shown. (A.G.W.)

23713 RECENT ADVANCES IN NEW HIGH MAGNETIC FIELD TECHNIQUES AT NATIONAL LABORATORIES OF FRASCATI, ITALY. G. C. Sacerdoti (National Synchrotron Labs., Frascati, Italy). Nucl. Instr. Methods, 20: 503-4 (Jan. 1963). (In English)

Work on pulsed and superconducting magnets is reviewed. Several coil materials and techniques were tested. At fields near 220 kG a single spiral coil of Cu withstood ~2200 pulses without definite damage. The critical point of this type of coil was found to be the insulation between succes-

sive turns. A superconducting coil working in liquid He, by which >36 kG was obtained, is described. A thermoswitch to short-circuit the coil was also built and tested. (A.G.W.)

23714 EXPERIENCE WITH FOIL SPARK CHAMBERS IN HIGH PULSED MAGNETIC FIELDS. E. D. Platner, J. R. Orr, G. E. Masek, and R. W. Williams (Univ. of Washington, Seattle). Nucl. Instr. Methods, 20: 505(Jan. 1963). (In English)

Small, thin-foil spark chambers were tested in the fringing field of a powerful pulsed solenoid. The pulse duration was 0.9 msec, and the peak field at the center of the magnet was 200 kG. A low-intensity 1.5 Bev/c pion beam from the Bevatron was directed down the axis of the coil and through the spark chamber at the end of the magnet. Pictures were taken with the field on and with the field off. No difference in the appearance of tracks with and without field was discerned. It is concluded that stainless-steel foil spark chambers can be used satisfactorily in pulsed magnetic fields. (A.G.W.)

23715 A SUB-NANOSECOND TIME-OF-FLIGHT CIRCUIT UTILIZING THE INHERENT MODULATION OF A SYNCHROTRON BEAM. R. L. Anderson and B. D. McDaniel (Cornell Univ., Ithaca, N. Y.). Nucl. Instr. Methods, 21: 235-42(Feb. 1963). (In English)

A relatively simple circuit having a resolution of 0.3 nsec was built and used to separate particles of different mass generated by the Cornell 1.4 Bev electron synchrotron. The circuit has been in operation for a year and has played a central role in several experiments. The vernier chronotron principle of Cottini and Gatti is used so that no high-speed electronics is required. The method utilizes the inherent radiofrequency bunching of the internal electron synchrotron beam to produce a pulse-modulated photon beam. The radiofrequency itself is used to perform the timing. The circuit may also be used to make a direct coincidence between two counters with a resolution of 0.4 nsec. (auth)

23716 A NANOSECOND TIME-TO-PULSE-HEIGHT CONVERTER OF HIGH STABILITY FOR mV-PULSES. W. Meiling, J. Schintlmeister, and F. Stary (Zentralinstitut fur Kernphysik, Rossendorf, Ger. and Technische Universitat, Dresden). Nucl. Instr. Methods, 21: 275-80(Feb. 1963). (In English)

A time-to-pulse-height converter is described consisting of a long-tailed pair containing a stabilizing negative feedback. Two such converter elements can be arranged as a differential converter of higher stability than the single converter element, and it can also be used as a coincidence circuit of high time resolution. In the quiescent state, the converter tubes are open. In this way a satisfactory operation of the circuit is possible with only a few millivolts of input pulse height. This is of importance while using semiconducting radiation detectors. The long-time stability of the converter during 24 hours is better than ±15 ps. Increasing the converter temperature by 20°C, a temperature coefficient of about 2.5 ps/°C was obtained. (auth)

23717 AN ECONOMICAL DOUBLE-DELAY-LINE AMPLIFIER. E. T. Patronis, Jr. (Georgia Inst. of Tech., Atlanta). Nucl. Instr. Methods, 22: 83-6(Mar. 1963). (In English)

The design, characteristics, and performance of an economical double-delay-line amplifier for use in nuclear pulse spectrometry are presented. The amplifier's performance is compared with commercial amplifiers. The amplifier, which costs less than $200 to construct, is found to have better resolution and noise characteristics than the commercial amplifiers with which it was compared. (auth)

23718 A TRANSISTORIZED STABILIZED HIGH VOLTAGE POWER SUPPLY 0-2000V, 3MA. D. T. Jovanović, B. M. Stojanović, and R. P. Ilić (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). Nucl. Instr. Methods, 22: 113-16(Mar. 1963). (In English)

A transistorized stabilized high voltage power supply 0 to 2000 v,3ma is described. The instrument is intended for precise spectroscopic energy measurements in nuclear physics as well as for all purposes where high stability and reproducibility are required. The performances of the instrument are as follows: regulation better than 0.01% for ±10% mains voltage variation, internal resistance less than 100 ohm, output voltage ripple less than 20 mv rms under maximum load conditions, temperature stability better than 0.003%/°C. The polarity of the instrument is reversible. (auth)

23719 A TUNNEL DIODE AND COMMON-BASE TRANSISTOR COMPLEMENTARY BISTABLE. V. Radeka (Institut "Rudjer Boskovic", Zagreb). Nucl. Instr. Methods, 22: 153-6(Mar. 1963). (In English)

A complementary bistable based on series-parallel circuit of one tunnel diode and two common-base transistors is given. The basic advantages of this circuit over presently known transistor or tunnel diode bistables are high speed, low energy triggering, and high-voltage output (compared to the tunnel diode voltage swing). The circuit is based completely on the semiconductor-resistor current steering logic. The speed obtained with 5 ma tunnel diode is about 250 Mc. (auth)

23720 A TWO STAGE MASS SPECTROMETER FOR NUCLEAR PHYSICS APPLICATIONS. PART II. W. A. P. Young, D. E. P. Silver, A. J. Hitchcock, and H. W. Wilson (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 22: 169-85(Mar. 1963). (In English)

A description is given of the main electronics features of a double magnetic stage mass spectrometer described previously. Particular emphasis is given to the details of the high stability accelerating voltage scanning and magnet supplies, the mass switching and the ion counting equipment. (auth)

23721 HIGH-SPEED SCALER STORAGE CIRCUIT. V. M. Lachinov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 6, 64-7(Nov.-Dec. 1962). (In Russian)

A scaler storage circuit scheme with 2- and 5-scaler coefficient was designed for use as a wide range periodic pulse repetition frequency divisor. The maximum rate with divisor coefficient 2 was 150 Mhertz and the minimum ~4 Mhertz; with divisor coefficient 5 the performance rate is from ~80 to 1 Mhertz. Consequent connection of the circuit results in decade scaling down of incoming signal pulse repetitions frequencies. (tr-auth)

23722 RESTORATION OF DATA IN THE MEMORY STORAGE TUBE BY UTILIZING THE PULSE ARRIVAL TIME INTERVAL. A. N. Sinaev (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 6, 67-9(Nov.-Dec. 1962). (In Russian)

A working program was developed for a multichannel pulse analyzer equipped with a storage tube where the stored memory data are restored into the time interval between the arriving pulses. (R.V.J.)

23723 TIME TO AMPLITUDE CONVERTER WITH SEMICONDUCTOR ELEMENTS. A. A. Ivanov and V. S.

Nesterenko. Pribory i Tekhn. Eksperim., No. 6, 75-7 (Nov.-Dec. 1962). (In Russian)

Descriptions are given of a time to amplitude converter operating with semiconductors. High-frequency diffusion transistors P-403, P-403A, and P-411 and tunnel germanium diodes are used with the converter. The time resolution with one FEU-33 is 3×10^{-10} sec (the curve of delayed coincidences from Co^{60} at half height) at channel width is 1×10^{-10} sec. (tr-auth)

23724 NANOSECOND PULSE GENERATOR. V. M. Gorbachev, V. N. Korolev, and N. A. Uvarov. Pribory i Tekhn. Eksperim., No. 6, 81-3(Nov.-Dec. 1962). (In Russian)

A design is given of a generator with a delayed positive feed-back on the second output tube. The device generates 5 nsec pulses with frequency up to 170 Mhertz. The oscillation amplitude at 37.0 ohm load is 120 v. The oscillation period is stabilized by a delay line. (tr-auth)

23725 PRODUCTION OF SILICON AND Ge ION BEAMS BY MEANS OF HIGH-FREQUENCY SOURCE. V. F. Kozlov, V. Ya. Kolot, and Chei-chin Sung (Khar'kov State Univ.). Pribory i Tekhn. Eksperim., No. 6, 116-18(Nov.-Dec. 1962). (In Russian)

Production of Si^+ and Ge^+ ions by high-frequency ion source with a discharge in $SiCl_4$ vapors is described and optimum conditions are found for production of 0.5 μamp current ion beams. (tr-auth)

23726 RISE-TIME CHARACTERISTICS OF PHOTOMULTIPLIERS WITH LARGE CATHODES. L. Ozhdyani, V. S. Pantuev, and M. N. Khachaturyan (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 6, 119-20(Nov.-Dec. 1962). (In Russian)

An improved timing was developed for the leading pulses of FEU-44 and FEU-45 photomultipliers used with scintillation and Cherenkov counters operating with fast coincidence schemes. (R.V.J.)

23727 ELECTRON BEAM PRECISION MONITORING. I. A. Grishaev, V. M. Grizhko, D. I. Sikora, B. I. Shramenko, and V. A. Shkoda-Ul'yanov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 6, 123-4(Nov.-Dec. 1962). (In Russian)

An electron current monitoring device for measuring accelerated electron beams at 10^{-13} to 10^{-8} amp is described. The instrument order of error with ionization current and high-frequency interferences is about 4×10^{-14} amp; total error at the integration of over 10^{-11} amp current is about 0.7%. (tr-auth)

23728 PREPARATION OF Co, Cu, AND Ag TARGETS AND RADIOACTIVE SOURCES. Z. V. Pastukhova. Pribory i Tekhn. Eksperim., No. 6, 126-7(Nov.-Dec. 1962). (In Russian)

Preparations of Ag, Co, and Cu radiation sources and targets by electrolytic precipitation on Al cathode are described and optimum conditions are tabulated. The developed targets of 0.1 to 0.4 mg/cm^2 Co^{60}, 1.4 mg Cu^{64}, and 48.1 mg Ag^{109} were used in experiments with thermal neutron capture. The results showed that electrolytic precipitation can be successfully used in preparations of targets and sources. (R.V.J.)

23729 PREPARATIONS OF CHROMIUM FOILS FOR NUCLEAR RESEARCH. V. N. Mednyak, A. P. Klyucharev, and A. D. Nikolaichuk (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 6, 128(Nov.-Dec. 1962). (In Russian)

Descriptions are given of chromium foil preparation by electrolytic bath precipitation of $H_2Cr_2O_7$ from $BaCrO_4$ followed by room temperature electrolysis in a polished degreased copper cathode. Three μ chromium foils precipitated from chromic acid were elastic with sharply outlined edges. (R.V.J.)

23730 MEASUREMENTS OF NUCLEAR QUADRUPOLE RESONANCE SPECTRA AT LOW TEMPERATURE. V. P. Babenko and D. F. Baisa (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 6, 138(Nov.-Dec. 1962). (In Russian)

Measurements of nuclear quadrupole resonance spectra were carried out in a metallic cryostat at liquid hydrogen and helium temperature. (R.V.J.)

23731 A SENSING ELEMENT FOR THE CONTINUOUS MEASUREMENT OF SMALL DEVIATIONS IN LIQUID SOLUTION CONCENTRATION USING RADIOACTIVE RADIATION. M. Yu. Borukhov, V. Ts. Ivashev, and V. F. Kleymenov. Radioaktivn. Izotopy i Yadernye Izlucheniya v Nar. Khoz. SSSR, Tr. Vses. Soveshch., Riga, 1: 253-6 (1961).

The sensitive element of an instrument for sensing small deviations in concentration, in which a temperature correction is automatically introduced, consists of a hydrometer and a thermometer in one unit (the hydrometer tube is filled with mercury or alcohol). The parameters of the sensitive element are such that the linear values of the hydrometer immersion depth and the height to which the liquid rises in the tube are equal over a wide range of temperatures. The radioactive isotope floats on the surface of the thermometric liquid, and its radiations are received by pulse counters connected to an electronic unit. The output from the electronic unit is connected to the concentration indicator and a signal device. The measurement system may be of relay or proportional type, depending on the number of counters and the way in which they are installed. An overflow is used to ensure that the liquid being measured is at a constant level. Formulas are given for calculating the volume and weight of the thermometric liquid. (Referativnyy zhurnal, Khimiya, No. 4, 1962)

23732 A MANY-CHANNEL ANALYZER WITH ELECTROSTATIC STORAGE IN THE DECIMAL SYSTEM. Richard Mueller (Eidgenossische Technische Hochschule, Zurich). Z. Angew. Math. Phys., 13: 13-26(1962). (In German)

A 64-channel pulse-height analyser is described that operates in decimal system throughout. It thus contrasts with normal memory systems that employ the binary system, and provides thereby considerable simplification in information display. The memory system is electrostatic. Results are displayed on the screen of a cathode ray oscillograph in code form that not only depicts the actual counts but also provides a direct survey of the overall spectrum. (auth)

23733 APPARATUS FOR CONTACT-FREE QUALITY CONTROL USING THE METHOD OF COMPARISON WITH A STANDARD UNDER IONIZING RADIATION. Jiří Oppelt and Jaroslav Hladik. Czechoslovak Patent 96,354. Aug. 15, 1960.

A new method is proposed for generating the alternating input signal for an ionization chamber. The equipment consists of a rotating ionization chamber, a radiation source, and a standard object. The ionization chamber has at its center a stationary collector, which is the axis of rotation of a cylindrical screen to which the radiation source is attached. The radiation going directly into the chamber is screened. The radiation directed outside the chamber is

alternatively reflected either from the object tested, or from the standard, and falls on the collector electrode. The ionization current arising has a half-wave form, the amplitude of which depends on the properties of the tested or the standard object. The indicator connected to the output of an a-c amplifier is calibrated directly in units of the controlled variable and indicates the derivation between the properties of the object and the standard. (Referativnyy zhurnal, Avtomatika i radioelektronika, No. 4, 1962)

23734 WELL LOGGING APPARATUS. Frank F. Johnson (to Schlumberger Well Surveying Corp.). U. S. Patent 3,089,954. May 14, 1963. Filed June 20, 1956.

A scintillation spectrometer apparatus for gamma well logging is designed in which only pair production interactions are detected. The apparatus includes a neutron source, a principal scintillation element, an auxiliary scintillation element, a pulse height analyzer, and a triple coincidence circuit. (D.L.C.)

23735 X-RAY FLUORESCENT SCREEN. Walter J. Hushley (to Westinghouse Electric Corp.). U. S. Patent 3,089,956. May 14, 1963. Filed July 10, 1953.

An optical screen for electronic image intensifier tubes is designed in which the separation between the zinc sulfide phosphor particles and the photoelectric particles is made small for increased accuracy in the reproduction of the x-ray image. The screen has a network of sockets or holes which are filled with phosphor, and the photoemissive material is deposited on top of a conductive coating on the screen. (D.L.C.)

Radiation Detection

Refer also to abstracts 24230, 24255, and 24364.

23736 (AD-285660) DEVELOPMENT OF RADIAC CALIBRATOR AN/UDM-2 (XE-2). Results of Phase I Studies. Final Type Report No. 1, July 1, 1961 to November 15, 1961. (Tracerlab, Inc., Waltham, Mass.). Aug. 1962. Contract DA-36-039-SC-87320. 30p.

Activities in a program to develop and fabricate radioactive devices for use in the calibration of U. S. Army radiac equipment and those items of equipment to be service tested are reported. A summary of the existing radiac equipment characteristics is presented. Data describing the items of equipment, their measured and expected operation in the calibrator unit, and their limitations in this respect are included. Tests and measurements made with existing sources are described. A brief discussion of problems encountered with each unit, and specific solutions to these problems are included. The expected operation of the calibrator with all the radiac equipment specified in the contract is described. There are obvious shortcomings to the calibrator using an isotopic source of radiation. An alternate approach is described using a portable x ray generator. A discussion of two approaches to the x ray apparatus design is presented, using either standard x ray generator techniques or a new, smaller, transistorized design. (auth)

23737 (AD-402352) COUNTER MODELS AND APPLICATIONS TO DETECTION PROBLEMS. Technical Report No. 87. Hans Zweig (Stanford Univ., Calif. Applied Mathematics and Statistics Lab.). Apr. 12, 1963. Contract Nonr-225(52). 82p.

Radiation detectors can be considered as estimators of the parameters of Poisson streams of discrete quanta. Mathematical models of dead time counters, coincidence counters, and photographic detectors are discussed. Specific applications of the models are considered, and methods for estimating the parameter of interest are presented. Quantum efficiency is defined and evaluated for coincidence and dead-time counters. The quantum efficiency of photographic detectors is also obtained for photographic detectors with and without reciprocity failure. Two problems-use of parallel and series arrangements of dead time and coincidence counters for particle spectrum analysis and for radar range determination are examined. (D.C.W.)

23738 (CRRD-1109) A PORTABLE RATE METER FOR MEASURING α AND β ACTIVITY. A. R. Jones (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1963. 20p. (AECL-1710)

An instrument is described that comprises a ratemeter, high voltage supply, and scintillation probe. The probe contains a ZnS(Ag) phosphor laid on a plastic scintillator. By the appropriate selection of amplifier gains and window thicknesses, α and β activity may be measured separately in the presence of one another and in a γ background. γ sensitivity is low but efficiencies have been computed for different energies. Although it is a line powered instrument it can function for 8 hr on internal rechargeable batteries for portable use. Salient features of the circuit are described and performance figures given. The setting-up procedure is appended. (auth)

23739 (HASL-133) ENERGY DEPENDENCE DETERMINATIONS IN THE 60-180 kev RANGE WITH AN X-RAY MACHINE OF VARYING OUTPUT. Arthur Shambon, Albert Zila, and Robert Sanna (New York Operations Office. Health and Safety Lab., AEC). Feb. 1963.

Adequate energy dependence calibrations of a Victoreen Cavity Chamber were achieved by utilizing filtered beams from a 250-kvp, pulsating industrial x ray machine. Energy correction factors with errors under ±5% were obtained for energies of 63, 105, 150, and 180 kev. These results compare favorably with NBS calibrations. The NBS errors are ±3%, using a constant potential x ray machine. A description of the calibration facility, the equipment used, and the procedure developed is given. (auth)

23740 (IA-802) ADAPTATION OF GAMMA DOSIMETRIC FILMS TO THERMAL NEUTRON DOSIMETRY. J. Strop (Israel Atomic Energy Commission, Rehovoth). Feb. 1963. 12p.

Gamma dosimetric films can be adapted for thermal neutron dosimetry by covering them with a cadmium filter which captures neutrons with subsequent emission of gamma rays. Such filtered films were calibrated using a known thermal neutron dose. The ratio of the neutron dose in rems to corresponding dose in rads of radiative capture gamma rays was found to be 0.57 if the latter is estimated by calculation, and 0.49 if it is estimated from the film blackening. The two figures agree to within less than the 20% error which is tolerated in health dosimetry. By reducing the filter thickness to the half-value layer for thermal neutrons the film blackening can be made to show the dose in rems of both gamma rays and thermal neutrons without distinction. (auth)

23741 (NP-12675) DERIVADOS LUMINISCENTES DEL BORAZOL, SU APLICACION AL CONTAJE DE NEUTRONES TERMICOS. Informe No. 77. (Luminescent Derivatives of Borazole, Its Application to Counting Thermal Neutrons. Report No. 77). G. J. Videla, M. A. Molinari, E. A. Rojo, O. A. Lires, and L. H. Casas (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1962. 7p.

The preparation of luminescent derivatives of borazole by a modification of the Groszos and Stafiej method and the usual purification method is described. The fluorescent excitation spectra were determined. The equipment and technique used and the type of graph obtained are described. Experiments made with these compounds in thermal neutron counters, using the compounds in solution, are described. The relative efficiencies found with different gamma backgrounds are given in tabular form. The results show that the use of these derivatives has some advantages over conventional counters for the detection of thermal neutrons. (tr-auth)

23742 (NYO-10261) SEVERAL TYPES OF SPARK COUNTERS USING THE SONIC SPARK LOCATION PRINCIPLE. H. W. Fulbright, J. A. Robbins, and A. K. Hamann (Rochester, N. Y. Univ.). Apr. 15, 1963. Contract AT (30-1)-875. 48p.

Experiments were carried out with a number of different types of pulsed chambers to verify the fact that sparks can be located by the sonic method to within a millimeter or less. Examples are given of special counters especially applicable to nuclear structure experiments. They are: an essentially one-dimensional counter, for use, for example at the focal plane of a magnetic spectrometer; a composite counter for fast neutron spectrometry consisting of two scintillation counters and a disc-shaped spark counter; an angular distribution apparatus in which the angular position of a charged particle emerging from a nuclear reaction is determined by use of a curved spark counter; a gamma pair spectrometer of the semicircular focusing type with two one-dimensional spark counters; and an angular correlation apparatus in which at least one charged particle is involved, its angle of emission being determined by sonic spark location. (M.C.G.)

23743 (RISÖ-57) DETERMINATION OF COUNT-RATE DEPENDENT CORRECTIONS BY THE SUBSTITUTION METHOD. J. Thomas (Denmark. Atomenergikommissionen. Forsøginstitut, Risø). Feb. 1963. 25p.

The subsitution method which is well known from the calibration of sets of weights is transcribed to the problem of finding count-rate dependent corrections in counters for nuclear radiation. The accuracy of the determination is calculated and an optimalized procedure is given. The method is demonstrated on a $4\pi\beta$ proportional counter. (auth)

23744 (TID-15831) A SIMPLE LOW-CURRENT THRESHOLD DETECTOR. R. F. Shea (Knolls Atomic Power Lab., Schenectady, N. Y.). Dec. 26, 1961. Contract [W-31-109-eng-52]. 2p.

The circuit of a simple threshold detector employing a Hoffman Uni-Tunnel (backward) diode is described. This very low current diode possesses a negative-resistance region and has a peak current of 20 μa. The d-c input signal is applied, together with a square wave current obtained from one of the 1N1313 regulators, to the HU-25. Below the trip point the diode acts essentially as a very low impedance and the square wave voltage across it is 10 mv or less. As the d-c input current is increased a point will be reached at which this a-c voltage will suddenly jump to about 0.4 v. This occurs for an input current of 7 μa or less, less than 5 μw input power. The 2N336 is supplied with a 9 volt square wave supply to the collector through the 39K resistor and an emitter bias of about 0.4 v. Under these conditions the collector voltage is a square wave of about 7 v. When the HU-25 switches, the 0.4 volt signal on the base is sufficient to saturate the transistor and the output drops to zero. (N.W.R.)

23745 (TID-16186(Rev.)) CIRCUITRY FOR A HIGH ALTITUDE GAMMA SPECTROMETRY SYSTEM. Richard B. Keener (Argonne National Lab., Ill.). Feb. 1963. Contract [W-31-109-eng-38]. 18p.

A method of obtaining gamma spectra in the upper atmosphere is described. An instrument package, containing a phoswich detector, phototube, solid state circuits, and a transmitter, is carried aloft by a meteorological balloon. The ground equipment includes a receiver and tracking system, circuits for processing the detected waveforms, and a multichannel pulse height analyzer and recording equipment. The system observes gamma energies between 0.3 and 3 Mev, rejecting charged particles above 0.25 Mev. The final data are provided in three forms: total count accumulated during a run, count rate vs altitude, and spectrum analysis of the energies observed. The advantages of this approach over that of using an airborne analyzer are discussed. Also described are a means of recording data on magnetic tape for later pulse height analysis, system testing, means of calibrating the equipment, and observations of circuit behavior during field operations. (auth)

23746 (TID-18552) A FEASIBILITY STUDY OF A HIGH SENSITIVITY FAST NEUTRON DOSIMETER. Quarterly Progress Report No. 1, January 1 to March 31, 1963. B. H. Chase, T. C. Pang, J. M. Swartz, and M. O. Thurston (Continental Electronics Corp., Columbus, Ohio). Apr. 1, 1963. Contract AT(11-1)-1226. 15p.

The feasibility of developing a semiconductor fast neutron dosimeter suitable for monitoring personnel exposure is being evaluated. A theoretical study was made of the silicon diode dosimeter. Fabrication and irradiation of test diodes are being performed. (M.C.G.)

23747 (TID-18647) NEUTRON DOSE AS MEASURED BY URANIUM FOIL IN THE HURST THRESHOLD DETECTOR. C. M. West (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). [May 2, 1963]. Contract [W-7405-eng-26]. 20p.

A method is described whereby two uranium foils of different U^{235} enrichment may be used in a nuclear accident dosimetry program. Data are presented showing that B^{10}-shielded uranium foil measurements in the threshold detector as developed by Hurst et al of the Oak Ridge National Laboratory indicate approximately 50% of the total neutron dose for a variety of measured neutron spectra. However, the expense of B^{10} shields precludes extensive field use of these units. Experiments were conducted using a combination of normal and depleted uranium foils to determine the feasibility of measuring the U^{238} fission activity without the use of B^{10} shield to compensate for thermal absorption in U^{235}. More than 50 observations were made in which the results of the two foils were compared with the results from the B^{10}-shielded foil. These observations were obtained from various neutron doses and several different neutron energy spectra. The results indicated that the two foil measurements, after mathematical adjustment to eliminate the contribution due to U^{235} activation, differed by $-7.8\% \pm 4.9\%$ from the shielded reference foils. The 95% confidence interval for the precision for a single measurement using the two foils was calculated to be $\pm 14.8\%$. It was concluded that these foils could be used as a substitute for the more expensive B^{10}-shielded foil in a nuclear accident dosimetry program without appreciable loss of precision or sensitivity. (auth)

23748 (USNRDL-TR-621) CALORIMETRIC MEASUREMENTS OF GAMMA RAY, FAST NEUTRON, AND CHARGED PARTICLE ABSORBED DOSES. E. R. Schleiger, N. Goldstein, and E. Tochilin (Naval Radiological Defense Lab., San Francisco). Jan. 28, 1963. 31p. (AD-403751)

The energy absorbed by aluminum, carbon, or tissue-equivalent (TE) material when exposed to gamma rays, fast neutrons, or 900-Mev alpha particles was measured with a microcalorimeter. The instrument was patterned after the one described by Reid and Johns, Rad. Res. 14: 1 (1961), but has an ethylene glycol bath instead of water. Spaced mylar sheets about 6-$\frac{1}{2}$ in. in diameter were mounted on one side of the absorber inside the evacuated cylindrical chamber in order that the detector could be thermally insulated in the direction of the beam without the presence of bath solution. Gamma absorbed dose rates as low as 2 rads/min were measured with the instrument. The dose rates obtained from the exposures to Co^{60} and Cs^{137} sources agreed with the output of the sources as measured with a National Bureau of Standards secondary standard cavity ionization chamber. Thirteen 10-min exposures of the TE absorber in the microcalorimeter to fast neutrons from the University of California 60-in. cyclotron resulted in absorbed dose measurements varying from 24 to 40 rads. The average absorbed dose value was 5% higher than the determination based on flux and spectrum measurements. Microcalorimeter exposures to the 900-Mev alpha particle beam from the University of California 184-in. synchrocyclotron gave absorbed doses that agreed reasonably well with ionization chamber determinations. (auth)

23749 A GEOMETRICAL CONSIDERATION IN THE DESIGN OF NEUTRON SPECTROMETERS. T. M. Sabine and J. D. Browne (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Acta Cryst., 16: 435-6(May 10, 1963). (In English)

It is shown how a gain in resolution can be obtained by adjusting the ratio between the source-to monochromator distance and the monochromator-to-specimen distance. Equations for both powder and single-crystal spectrometers are derived for calculating the maximum beam divergence as a function of the angle ratios $m = \tan\Theta/\tan\Theta_m$ and $k = \delta/\alpha$. A plot of the divergence vs k shows that k should be 1.5 to 1 for maximum resolution. (D.L.C.)

23750 USE OF A MULTICHANNEL ANALYZER FOR ELECTRON PROBE MICROANALYSIS. L. S. Birks and A. P. Batt (Naval Research Lab., Washington, D. C.). Anal. Chem., 35: 778-82(June 1963).

A transistorized 400-channel multi-channel analyzer attached to the electron probe microanalyzer increased the versatility and decreased the time required for many analyses. Three types of application are illustrated. The multichannel analyzer replaces a scanning crystal spectrometer for quick identification and semi-quantitative analysis of components. Quantitative analysis of mathematical unfolding of the energy spectra is made practical by the fast data collection of standard and unknown spectra; comparison of results by unfolding and from crystal spectrometer data shows differences of less than 4% of the amount present. Quantitative two-dimensional topographic display is obtained by multiscaler operation of the 400-channel memory system. (auth)

23751 STATISTICAL ASPECTS OF LIQUID SCINTILLATION COUNTING BY INTERNAL STANDARD TECHNIQUE. SINGLE ISOTOPE. R. J. Herberg (Lily Research Labs., Indianapolis). Anal. Chem., 35: 786-91(June 1963).

Equations are given by which the percentage error in a calculated rate, corrected for counting efficiency, can be determined. The equations are evaluated for a range of counting efficiencies, activities of internal standard, and counting times before and after internal standard addition. For routine counting the addition of 50000 dpm of C^{14} and 150000 dpm of tritium as internal standard activity, and a 1-min counting time after addition of internal standard, are adequate. (auth)

23752 QUANTITATIVE INTERPRETATION OF COLOR QUENCHING IN LIQUID SCINTILLATOR SYSTEMS. Harley H. Ross and Roger E. Yerick (Oak Ridge Inst. of Nuclear Studies, Tenn.). Anal. Chem., 35: 794-7(June 1963).

A general approach to the quantitative interpretation of color quenching in liquid scintillator systems is developed and applied to the specific case of C^{14} in dioxane scintillator. The observed linear relation between per cent quenching and concentration of color-quenching species permits the evaluation of quenching coefficients. In the perfectly general system, a complete series solution requires the use of a computer program. For systems in which the absorption spectrum of the colored material is simple, good agreement between predicted and observed quenching can be obtained by determining only a few coefficients. In the system investigated, agreement was achieved with the evaluation of only three coefficients. The linearity of color quenching makes it possible to estimate easily the amount of quenching in systems in which only quenching agent of known identity is present. In any system, a comparison of the predicted color quenching with the observed total quenching permits calculation of the amount of chemical quenching within the system. (auth)

23753 CHARACTERISTIC PARAMETERS OF GEIGER-MÜLLER COUNTER GASES. PROPANE–ARGON AND PROPANE–HELIUM MIXTURES. Richard G. Pannbacker and Robert W. Kiser (Kansas State Univ., Manhattan). Appl. Sci. Res., Sect. B, 41-8(1963). (In English)

The combination of the Wilkinson and the Deithorn-Kohman expressions of counter operation was tested under conditions in which different rare gases were used with the same quench gas as Geiger-Müller counter fillings. The gas multiplication factor was assumed to be a constant equal to 10^7 and the results obtained again appear to substantiate this choice. The physical significance of the parameters involved in the theoretical expression are related to the ionization cross sections and the energy necessary to produce an ion pair in the gases used. The results of the present study appear to substantiate the approach taken in the earlier work. (auth)

23754 NUCLEAR RADIATION DETECTORS WITH n-i-p STRUCTURE WITHOUT INLET WINDOWS. Paul Siffert and André Coche (Centre de Recherches Nucléaires, Strasbourg). Compt. Rend., 256: 3277-9(Apr. 8, 1963). (In French)

The first results obtained with lithium-diffused junctions on which a surface barrier was realized are reported. (tr-auth)

23755 THE EFFECT OF SELF ABSORPTION OF RADIATIONS IN A RADIATION SOURCE USED FOR MEASUREMENTS. E. B. Milevskii. Dokl. L'vovsk. Politekhn. Inst., 5: 286-92([1962] .

A thin layer of metallic Tl^{204} isotope with a radiant energy of 0.76 Mev is used as a β-ray emitter in a radioactive measurement device. With the increase in the layer thickness, the amount of γ radiation in the β spectrum increases as a result of complete absorption of β particles

by the radiation source, and the Tl^{204} gradually becomes an emitter of γ radiations with an energy of 0.0076 to 0.76 Mev. With the change in the layer thickness of the Tl^{204} emitter, the activity of the latter, after a sudden increase, then diminishes, asymptotically approaching a constant value—the field of saturation. Thus, for instance, when the layer thickness increases from 0.5 to 1 mm, the radiation activity increases by 250%, whereas at an increase from 2 to 2.5 mm, the activity increases by 50%. The study of self-absorption of an infinite lamella shows that the density of the radiant flux on the source surface has a limiting value that depends on the specific activity and absorption coefficient of the source. In cases where β or γ radiations are emitted by a source of large layer thickness, the degree of absorption depends on the energy of the β and γ radiations. The larger the thickness of the β source that fully absorbs electrons, the smaller the measuring sensitivity. Formulas were desired for computing such a layer thickness that ensures retention of β radiations; the absorption of β rays by sources of varying layer thickness are also described. (TCO)

23756 POLYETHYLENE CONTAINERS FOR LIQUID SCINTILLATION SPECTROMETRY. E. Rapkin and J. A. Gibbs (Packard Instrument Co. Inc., La Grange, Ill.). Intern. J. Appl. Radiation Isotopes, 14: 71-4(Feb. 1963). (In English)

Medium-density polyethylene vials were compared to glass vials for use in liquid scintillation counting. Lower backgrounds and increased efficiencies were observed with plastic vials. Glass is superior for storage and heating of samples. (auth)

23757 APPLICATIONS OF PHOTOMULTIPLIER SPACE CHARGE FOR MEASURING NEUTRONS IN γ BACKGROUND. G. A. Prokopets, V. I. Strizhak, and V. D. Chesnokova. Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 131-6(1963). (In Russian)

A method of selective neutron detection in a γ background was developed on the basis of variable organic scintillator de-excitation times. The scintillation detector (stilbene) had practically no response to γ rays in the neutron energy range 1 to 10 Mev. The performance of the spectrometer for a Po–Be source is described. (tr-auth)

23758 PHOTOSENSITIVITY AND JOSHI EFFECT IN COUNTERS. H. J. Arnikar, G. Rami Reddy, and S. N. Chakravarty (Banaras Univ., India). J. Electron. Control (1), 11: 385-94(Nov. 1961). (In English)

Joshi effect ($\pm\Delta i$), an almost instantaneous and reversible photo-variation of the discharge current (i), is studied in various types of discharge vessels, charged with air, H_2, and I_2 vapor, and excited by fields due to continuous and alternating potentials (V). i was observed by a counter-scaler, and/or a galvanometer after rectification. $\pm\Delta i$ was observed under γ rays from a 50 millicurie Ra–Be source, and various frequency bands of the visible. The intensity (I) was varied over 30 times using the former, and 500 times with the latter. A 100% negative effect is observed near and above the threshold V_m; it decreases with increase of V. $\pm\Delta i$ (disfavored by a prolonged discharge) occurs within a restricted range of conditions, viz. low I and V. As these are increased, a sharp inversion $+\Delta i \rightleftharpoons -\Delta i$ follows which is fully reversible in respect of I and V. The minimum inversion intensity and the inversion potential vary in the order: violet < blue < green < yellow < red and, $I_2 < H_2 <$ air. $\pm\Delta i$ is independent of, but possibly favored by, selective light absorption, other conditions being equal. Compared with the galvanometer, the use of a counter-scaler is better adapted as a detector over a wider range of operative conditions. A second inversion of $-\Delta i$ into $+\Delta i$ at large V, observed earlier, is now confirmed using a counter-scaler. The results agree with Joshi's theory that photoemission from an adsorption-like wall layer with a low work function formed under the discharge gives $+\Delta i$ per se. $-\Delta i$ is ascribed to a negative space charge produced near the cathode at large I and V. (auth)

23759 EXPERIMENTAL STUDIES ON THE PROPERTIES OF THE AIR GAP SPARK CHAMBER. Yoshinobu Matsukawa (Osaka City Univ.). Japan. J. Appl. Phys., 2: 239-44(Apr. 1963). (In English)

An investigation on an air gap spark chamber under atmospheric pressure, especially on its efficiency for detecting multiple tracks, is described. The particle trajectory in a gap is determined within a probable error of 0.5 mm with three spark gaps that are separated from one another by 10 cm. The maximum efficiency for detecting a single track obtained in this study is about 95%. The spurious sparks that are induced by the other spark are prevented by means of isolating each gap optically. (auth)

23760 SCINTILLATION SPECTROMETER WITH THE ELIMINATION OF THE COMPTON BACKGROUND. Zdzislaw Kotonski. Krajowe Symp. Zastosowan Izotopow Tech., Rogow, Pol., 1960, No. 4, 8-12(1961).

A method is suggested for suppressing the Compton background in gamma spectrum measurements using a scintillation spectrometer with two NaI(Tl) crystals connected in coincidence. The block diagram of the experimental system is given, and results of measurements of the gamma spectra of Co^{60}, Cs^{137}, and (Co^{60} + Cs^{137}) sources are reported. The gamma spectrum curve peaks correspond to the maximum energy of recoil electrons. It is reported that the resolution of the lines proved to be 20% less accurate than that of the photolines. (Referativnyy zhurnal, Fizika, No. 10, 1962)

23761 A SCINTILLATOR FOR THE RECORDING OF SLOW NEUTRONS. J. Krzuk and A. Zuber. Krajowe Symp. Zastosowan Izotopow Tech., Rogow, Pol., 1960, No. 14, 8-12(1961).

A scintillator is described for the recording of slow neutrons obtained by sintering natural B_2O_3 with ZnS(Ag) at 640°C. The efficiency of 10 and 24 cm^2 scintillators with respect to slow and fast neutrons and gamma quanta amounts to 10, 0.1, and 10^{-4}%, respectively. (Referativnyy zhurnal, Fizika, No. 10, 1962)

23762 DETERMINATION OF THE RADIATION DOSE FROM BETA-APPLICATORS. V. V. Bochkarev, A. N. Krongauz, T. N. Sokolova, and L. V. Timofeev. Med. Radiol., 8: No. 2, 66-73(Feb. 1963). (In Russian)

A method for counting the doses absorbed from beta-applicators of P, Y, Pn, and Tl is described. The method is based on Levinger's formula. Tables and nomograms, which determine the value of doses absorbed at diverse depths of tissue by the specific activity and thickness of the applicator, are given. (P.C.H.)

23763 LOGARITHMIC COUNTING RATE METER. Eiji Kaneko (Hitachi Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 299-305(Apr. 1961). (In Japanese)

A new transistorized logarithmic counting rate meter was developed. It was designed for use in the startup region of a nuclear reactor. The experimental data of this device are given as follows: (1) Counting region: 0.3 cps to 30 kcps. (2) Accuracy: ±0.1 decades. (3) Pulse resolution:

Better than 1 μsec. (4) Discrimination level: −0.1 to −10 v pp. (5) Stability: Better than ±0.05 decades for ±15% change of line voltage and better than ±0.1 decades for 0 to 40°C change of room temperature. (6) Drift: ±0.1 decades/8 hr. (auth)

23764 AN ASSESSMENT OF CHERENKOV DETECTORS AS FISSION PRODUCT MONITORS IN WATER COOLED REACTORS. S. E. Rippon (AEI Research Lab., Aldermaston, Eng.). Nucl. Instr. Methods, 21: 185-91 (Feb. 1963). (In English)

Theoretical considerations and experimental investigations of a Cherenkov fission product detector system are described. Similar trials, on the MERLIN reactor, with ion exchanger and delayed neutron systems have permitted direct comparisons. The poor discrimination of β-ray energy outweighs the high percentage of fission products detected and the high β-ray sensitivity. This results in a relatively poor fission product sensitivity, as used, of 2.8 cm^2 of bare fuel, in the presence of the other reactor coolant activity. The higher fission product-to-background ratio in samples from individual fuel channels gives adequate sensitivity. In such a system, the Cherenkov detector has the advantages of simplicity over the ion exchange system and better delayed response than the delayed neutron systems. (auth)

23765 CHERENKOV DETECTORS FOR THE MEASUREMENT OF REACTOR POWER. S. E. Rippon (AEI Research Lab., Aldermaston, Eng.). Nucl. Instr. Methods, 21: 192-6(Feb. 1963). (In English)

Devices to measure the Cherenkov radiation from a water-cooled reactor core and from the N^{16} activity in the coolant water are described. The two systems are assessed as power monitors. The reactor core detector provides an alternative to the conventional ionization chamber for a reactor shut-down device. The N^{16} detector provides a sensitive wide range power monitor which is independent of core configuration and burnup. (auth)

23766 FAST NEUTRON SPECTROSCOPY WITH SOLID STATE DETECTORS. M. Birk, G. Goldring, and P. Hillman (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Instr. Methods, 21: 197-201(Feb. 1963). (In English)

A polyethylene proton radiator placed in front of a solid-state detector was used for fast neutron spectroscopy. Protons scattered at small forward angles were detected, giving a resolution of 270 kev for neutrons of 6 Mev. The possibility of using internal (n,p) and (n,α) reactions in the silicon of the detector for fast neutron spectroscopy was investigated. A resolution comparable with that observed for direct detection of charged particles was obtained. For neutrons in the region of 6 Mev, the cross sections were found to be of the order of 50 millibarns. The construction of a detector made of Si^{29} separated isotope is suggested. The reaction $Si^{29}(n,\alpha)Mg^{26}$ resonates at $E_n = 5.35$ Mev, indicating a level of 15.96 Mev in Si^{30}. (auth)

23767 FIELD CURVATURE AS A SOURCE OF SYSTEMATIC ERRORS IN NUCLEAR EMULSION MEASUREMENTS. D. Anghelescu and J. S. Auslaender (Polytechnical Inst., Bucharest). Nucl. Instr. Methods, 21: 202-8 (Feb. 1963). (In English)

It is shown that curvature of the microscopic field of view may give rise to systematic errors in nuclear emulsion measurements, especially if dip or polar angles are concerned. Simple correction procedures are outlined. (auth)

23768 NUCLEAR INTERACTION CORRECTION FOR DEUTERON SCINTILLATION COUNTING. R. Eisberg, S. Mayo, and W. Schimmerling (Comision Nacional de Energia Atomica, Buenos Aires). Nucl. Instr. Methods, 21: 232-4(Feb. 1963). (In English)

Charged particles entering a thick scintillation counter occasionally suffer a nuclear interaction before they are stopped by electronic interactions, thereby producing pulses of smaller than maximum height. This effect, which can contribute an important correction to certain experiments, was measured for 26.8-Mev deuterons incident upon NaI and plastic scintillators. (auth)

23769 PARALLEL PLATE HALOGEN COUNTER FOR HIGH INTENSITY RADIATION. D. Srdoč (Institute "Ruder Bošković," Zagreb). Nucl. Instr. Methods, 21: 243-6(Feb. 1963). (In English)

A parallel-plate halogen counter is presented which can be used for beta and gamma radiation measurements up to 1000 r/hr or more. The counter has high internal amplification resulting in high current up to 100 μa, depending on the working voltage. It was observed that for this counter the recovery time is equal to the dead time. A simple relation between the average output current and radiation intensity is given The method of filling the counter with bromine and neon resulting in reliable and reproducible properties is described. (auth)

23770 RAPID COINCIDENCE TRANSISTORIZATION. J. C. Dumas, C. Aubret, and P. Benoit (College de France, Paris). Nucl. Instr. Methods, 21: 325-5(Feb. 1963). (In French)

A description is given of some transistorized standardized and stable circuits for rapid coincidence, lately used around Saclay's synchrotron Saturne. The resolution obtained is 4 nanoseconds for a circuit comprising three ways in coincidence and one way in anticoincidence and the whole of the circuit answers without error as long as the difference between the components of a pulse doublet is greater than 4×10^{-9} second. (auth)

23771 A NEW GAMMA DETECTOR FOR FAST COINCIDENCE MEASUREMENTS WITH A GOOD ENERGY RESOLUTION. Th. J. De Boer, S. S. Klein, E. W. Ten Napel, and J. Blok (Vrije Universiteit, Amsterdam). Nucl. Instr. Methods, 21: 347-8(Feb. 1963). (In English)

A NaI(Tl)-plastic combination detector was devised for fast coincidence measurements with good energy resolution. Co^{60} was used to illustrate its performance. (D.L.C.)

23772 RESPONSE OF IONIZATION CHAMBERS FILLED WITH LIQUID HEXANE TO BEAMS OF FAST NEUTRONS. D. Blanc, J. Mathieu, and P. Vermande (Centre de Physique Nucleaire, Faculte des Sciences, Toulouse). Nucl. Instr. Methods, 21: 349-50(Feb. 1963). (In French)

A parallel-plate-electrode ionization chamber is described that is filled with n-hexane. This chamber is able to detect neutrons, because of the ionization produced by recoil protons from neutron-scattering events within the chamber. The lower limits to the fluxes that can be measured with this chamber are 100 $n/cm^2/sec$ at 3 Mev and 1000 $n/cm^2/sec$ at 14.6 Mev. (T.F.H.)

23773 NUCLEATION IN BUBBLE CHAMBERS. A. G. Tenner (Universiteit, Amsterdam). Nucl. Instr. Methods, 22: 1-42(Mar. 1963). (In English)

A new approach is presented to the creation of vapor bubbles in superheated liquids by high-energy charged particles. A compilation is given of the theoretical work done on both spontaneous nucleation and nucleation under the influence of charged particles. The processes are compared with another nucleation process, the condensation of

supersaturated vapors. Some striking differences are demonstrated. It is seen to be plausible that nucleation in liquids through the action of charged particles is a thermal process, for which the liquid must be heated locally. The amount of heat necessary to create a bubble that can grow to visible size was calculated for a number of practical cases. The energies are 8.2 ev for helium, 12.0 ev for hydrogen and 256 ev for propane. It is shown that this amount of heat must be concentrated in an area with a diameter of about 10 nm at the beginning of the nucleation process. The non-occurrence of a relativistic increase in the bubble density—velocity curve supports the assumption that, at least in hydrogen, the bubbles are created by δ-electrons. In the case of helium a detailed calculation is given of the way in which a δ-electron transfers its energy to the liquid. It can be shown that direct heating of the liquid by electrons is only a minor effect, but that excitation and ionization can produce the necessary heat for bubble formation by their subsequent processes, deexcitation and recombination. In the presented model the liquid is treated as gas-like, only those effects which are observed in gaseous helium are incorporated in the mechanism. It is made clear that a single deexcitation or recombination event is not sufficient to create a bubble, but that a number of them have to cooperate. A discussion about bubble creation in hydrogen and in more complex liquids is presented. The influence of molecular effects, the possibility of collective excitations and the consequences of complex chemical behavior are estimated. It is seen to be plausible that the nucleation process takes place more easily in more complex liquids, because of the greater variety of ways in which the charged particles can transfer their energy to the liquid. Mention is made of the possibility that, in complex liquids, bubbles can be created by an excitation of lower atomic levels rather than by the production of δ-electrons. This may explain the occurrence of a relativistic rise in the bubble density–velocity curve in liquids like freon. (auth)

23774 DEPENDENCE OF LINE WIDTHS OF SCINTILLATION COUNTERS WITH NaI(Tl)-CRYSTALS ON INTEGRATION TIME CONSTANT. K. Fraenz and Kl. Mueller (Telefunken Forschungs-Institut, Ulm, Ger.). Nucl. Instr. Methods, 22: 43-4(Mar. 1963). (In English)

The output pulses of the multiplier are integrated with a fixed large time constant ϑ_1 and simultaneously with an adjustable time constant $\vartheta_2 \leqq \vartheta_1$; the pulse amplitude can thus be alternatively defined by two distinct procedures: by measurement of the total or of a partial charge of the pulses. In a coincidence experiment with two single channel spectrometers I and II, spectrometer II records the amplitude distribution of such pulses integrated with time constant ϑ_2, as are coincident with pulses of fixed total charge, selected by spectrometer I. The coincidence line shows the small effect of incomplete integration upon the total line width, the large "intrinsic" contribution of the crystal to the line width being suppressed by the coincidence arrangement. (auth)

23775 PULSE SHAPE DISCRIMINATION WITH SOLID STATE DETECTORS. J. A. Scheer (Universität, Heidelberg). Nucl. Instr. Methods, 22: 45-7(Mar. 1963). (In English)

A method is described that enables one to differentiate between particles that are stopped in the depletion region of a solid state detector from others that penetrate it. (auth)

23776 BACKSCATTERING EFFECT ON GAMMA-RAY SPECTRA RECORDED BY SCINTILLATION SPECTROMETERS. H. E. Bosch and Maria C. Caracoche (Universidad Nacional de La Plata, Argentina). Nucl. Instr. Methods, 22: 77-82(Mar. 1963). (In English)

Gamma radiation spectra emitted by standard nuclides are recorded by a scintillation spectrometer coupled to a multichannel pulse height analyzer. The variation in intensity of the backscattering peak is studied as a function of the source-to-crystal distance, for different energies, with and without a lead housing. The effect of the interposition of a collimator between source and crystal is also analyzed. Finally, the variation in peak intensity of the backscattering effect through addition of different thickness of aluminum and beryllium in the source backing is considered. The optimum geometry for recording electromagnetic radiation spectra is indicated. (auth)

23777 A SOLENOIDAL β-RAY SPECTROMETER FOR COINCIDENCE EXPERIMENTS. H. Verheul, J. J. Van Rooijen, Th. S. Kapteyn, and J. Blok (Universiteit, Amsterdam). Nucl. Instr. Methods, 22: 93-100(Mar. 1963). (In English)

To perform (e^-,γ)-coincidence experiments, a solenoidal β-ray spectrometer with a maximal solid angle of 10% was built. The construction of this spectrometer and the experimental tests are described. Its figures of merit are compared with those of other solenoidal spectrometers. (auth)

23778 FINITE SOLID ANGLE CORRECTIONS FOR NaI(Tl) CRYSTALS WHEN PULSE HEIGHT SELECTION IS EMPLOYED. P. J. Twin and J. C. Willmott (Univ. of Liverpool). Nucl. Instr. Methods, 22: 109-12(Mar. 1963). (In English)

Measurements were made of the relative contributions of different annular sections of a 5 in. × 6 in. NaI(Tl) crystal to the total energy peak. The results obtained were used to calculate the correction factors due to finite angle effects in angular correlations when only the counts in the total energy peak are included in the analysis. (auth)

23779 THRESHOLD DETECTOR FOR POSITION AND ENERGY DETERMINATION. K. H. Lauterjung, J. Pokar, B. Schimmer, and R. Staeudner (Universität, Cologne and Max-Planck-Institut für Kernphysik, Heidelberg). Nucl. Instr. Methods, 22: 117-21(Mar. 1963). (In German)

Solid-state radiation detectors with suitable contacts produce pulses with a rise time depending on the position of the entering particle. That slope of these pulses, which is independent of the position, is proportional to the energy of the particle. These two properties are used for the simultaneous registration of position and energy. (auth)

23780 FADING PHENOMENA IN NUCLEAR EMULSIONS. B. Sen and M. L. Chatterjee (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Instr. Methods, 22: 122-4(Mar. 1963). (In English)

Eradication of background grains in emulsion plates was studied with potassium ferricyanide solution in hypo. The special feature of this method is that it can be applied after the processing of the plates. The effect of various parameters such as time of treatment, concentration, and temperature on reduction has been studied in detail. (auth)

23781 4-METER CAUCHOIS SPECTROMETER FOR NEUTRON-CAPTURE γ-RADIATION RESEARCH. O. I. Sumbayev and A. I. Smirnov (Ioffe Inst. of Physics and Tech., Leningrad). Nucl. Instr. Methods, 22: 124-37 (Mar. 1963). (In English)

A 4-meter bent-crystal diffraction Cauchois spectrometer with scintillation counter recording is described.

The instrument is installed at the horizontal channel of a BBP-M reactor and is designed for precision measurements of energies and relative line intensities in neutron-capture γ-radiation spectra. Resolution of the instrument is $\Delta E/E[\%] = (1 \text{ to } 1.5) \times 10^{-3}E$ [kev]. The transmission provided permits operation with sources having neutron capture cross-sections above 1 barn. A built-in transfer gear permits investigation not only of γ-radiation due to a direct (nγ)-reaction, but also of γ-radiation emitted by radioactive isotopes produced, provided their lifetimes exceed 10 sec. A theory of instruments of this type is presented, as well as experimental data obtained with cadmium and copper sources. (auth)

23782 BACKSCATTERING AND NOISE IN A SCINTILLATION DETECTOR FOR A BETA-RAY SPECTROMETER. H. Paul and I. Hofmann (Austrian Research Assn. for Atomic Energy, Inc., Seibersdorf). Nucl. Instr. Methods, 22: 141-8(Mar. 1963). (In English)

A scintillation detector for a Siegbahn-Slätis beta-ray spectrometer is described. The contributions to the background pulse spectrum due to photomultiplier, light guide, and scintillator are shown; the phomultiplier contribution can be minimized by proper choice of the focusing potential. Data are given on the non-linear energy response of the plastic scintillator. The pulse height distribution due to the backscattering of monoenergetic electrons from the scintillator was found to decrease toward small pulse height. The use of hollow detectors is shown to give a considerable reduction of counting losses due to backscattering. Curves are given from which the backscattering correction for a hollow detector can be read for various energies and discrimination levels. The backscattering correction per unit pulse height in the limit of zero discrimination level is given for various detector shapes and energies and compared to the values found by others. An attempt to derive this correction theoretically gives qualitative agreement with experiment. (auth)

23783 A NEW TYPE OF INTERNAL PAIR SPECTROMETER. B. Rosner (Hebrew Univ., Jerusalem), R. Kalish, and M. Loebenstein. Nucl. Instr. Methods, 22: 149-52(Mar. 1963). (In English)

A new type of internal pair spectrometer is described. It is capable of measuring pairs emitted with small angles between both members of the pair, from which the internal pair formation conversion coefficient may be calculated. The spectrometer is most convenient for π-γ coincidence technique, and in some cases for determining the multi polarity of the electromagnetic transition. (auth)

23784 A SEMICONDUCTOR MONITOR FOR NUCLEAR RADIATIONS. M. E. Moncaster, D. C. Northrop, and J. A. Raines (Services Electronics Research Lab., Baldock, Herts, Eng.). Nucl. Instr. Methods, 22: 157-64 (Mar. 1963). (In English)

A method is described of making encapsulated p-n junction radiation counters from high resistivity p-type silicon. They can be used to monitor alpha, beta, and gamma rays, with discrimination in mixed fluxes, and are sufficiently robust and reliable for use in general purpose equipment. A portable transistorized indicator unit was designed for use with these counters incorporating a loudspeaker output and logarithmic ratemeter. The counting threshold of the instrument is reached when 70 kev is absorbed in the depletion layer of the junction, so that all charged particles above this energy are counted. Gamma rays give Compton interactions only, with a sensitivity of about 1 mr/hr for Co^{60} gammas. The energy response of the instrument over a range of gamma photon energies has not yet been determined. (auth)

23785 A THRESHOLD GAS ČERENKOV COUNTER. M. Vivargent, G. Von Dardel, R. Mermod, G. Weber, and K. Winter (CERN, Geneva). Nucl. Instr. Methods, 22: 165-8(Mar. 1963). (In English)

A description is given of a type of conventional threshold gas Čerenkov counter, particularly well adapted for the use in high-energy beams. A very simple method was found to obtain the best collection of the Čerenkov light. When utilized for the detection of 6 Bev/c electrons, its rejection against heavier particles is better than 10^{-4}, and its efficiency better than 99%. (auth)

23786 DOSIMETRY OF NEUTRONS FROM Ra–Be SOURCE BY OPTICAL GLASS. Kakuji Yamamoto (Tokyo Metropolitan Isotope Center). Oyo Butsuri, 31: 338-41 (May 1962). (In Japanese)

A simple, small-scale laboratory method to determine the linear relation between the neutron dosage and the γ-induced color shade of glasses is described. Sample glasses of borosilicate crown glass (BK-7) and flint glass (F-2) were used. The relation was established by first determining the shade of the induced color using a 200-C Co^{60} source, then a neutron and γ-ray mixed source of Ra–Be (0.1-C, and 3×10^3 n/sq. cm/sec). It was observed that BK-7 glass can be used for measuring higher dosages than F-2 glass. (OID)

23787 INDUCEMENT OF COLOR TO MANGANESE GLASS BY γ-RAY IRRADIATION AND ITS APPLICATION TO DOSIMETRY. Kakuji Yamamoto (Tokyo Metropolitan Isotope Center). Oyo Butsuri, 31: 359-63(May 1962). (In Japanese)

Test results indicated that Mn glass used in dosimetry could maintain sufficient color stability within dosage ranges of 3.5×10^4 to 10^7 r. Glass samples containing 90% MnO by weight were irradiated by a 1-kC Co^{60} source at dose rates of 6.1×10^4, 10^5, 2.5×10^5, and 5.0×10^5 r/hr in air at 18 ± 3°C up to dosage levels from 1.22×10^4 to 10^7 r. The natural fading of the induced color, and the effects of factors such as the ultraviolet, visible rays of light, heat, and d-c electric tension on the quickening of color fading were described. The induced color at 430 mμ was not affected either by the factors or by irradiation. (OID)

23788 SUM-COINCIDENCE GAMMA SPECTROMETERS. V. A. Sergienko, L. A. Popeko, and Yu. S. Egorov (Leningrad State Univ.). Pribory i Tekhn. Eksperim., No. 6, 28-35(Nov.-Dec. 1962). (In Russian)

A complex coincidence γ spectrometer operating without Compton background or with considerably attenuated background is described. The rapid coincidence scheme eliminates the total cascade energy peak resulting in an improved spectral resolving power. A feasibility of separating triple cascade γ quanta by γ spectrometer using two counters is discussed. (tr-auth)

23789 HYDROGEN BUBBLE CHAMBER ILLUMINATION SCHEME FOR PHOTOGRAPHING SMALL SIZE BUBBLES. V. M. Gorbunov. Pribory i Tekhn. Eksperim., No. 6, 41-5(Nov.-Dec. 1962). (In Russian)

Various methods are suggested for reducing the diameter of bubbles considering the image diffraction theory and the photometric analysis of illumination in depth and within the vision range. A new autocollimating scheme of illumination a thick mirror that magnifies the source while reducing the track's mirror image to the intensity of their

mirror images from non-illuminated transparent glass surfaces was developed. (tr-auth)

23790 PROPERTIES OF EMULSION CHAMBERS SATURATED WITH WATER OR ETHYLENE GLYCOL. To Ying Seb, L. F. Kirillova, Z. F. Korbel, and M. G. Shafranova (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 6, 46-8(Nov.-Dec. 1962). (In Russian)

Descriptions are given of two hydrogen-filled emulsion chambers. One chamber was saturated with water, the other with $(CH_2OH)_2$. The nuclear composition, the path/energy ratio, sensitivity, and vertical and linear shrinkage coefficients are described. It is shown that the hydrogen-saturated emulsions are very effective for studies of hydrogen reactions. (tr-auth)

23791 A PROPORTIONAL COUNTER WITH A BACKGROUND SHIELDING SYSTEM FOR RADIOCARBON AGE ESTIMATING METHOD. V. I. Kokochashvili, G. M. Marianashvili, A. A. Burchuladze, and K. G. Dzhaparidze (Tbilisi State Univ., Georgian SSR). Pribory i Tekhn. Eksperim., No. 6, 52-4(Nov.-Dec. 1962). (In Russian)

A design is given of a 6-liter high-pressure proportional counter with a special scheme for reducing and eliminating radioactive and cosmic background. (tr-auth)

23792 EFFICIENCY OF CHERENKOV COUNTER FOR RECORDING HIGH-ENERGY γ RAYS. A. S. Belousov, S. V. Rusakov, E. I. Tamm, and L. S. Tatarinskaya (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 6, 125(Nov.-Dec. 1962). (In Russian)

An estimate was made of the efficiency of a Cherenkov counter 100 mm diam. and 100 mm long cylindrical radiator with 3.87 g/cm^3 density, 1.548 refraction index; 2.38 cm radiation unit, and 13 Mev critical energy TF-1 flint glass. The counters were equipped with photomultipliers with photocathode sensitivity of not less than 50 μa/lm. (R.V.J.)

23793 RECORDING OF COMBINED SCATTERING WITH IKS-11. D. S. Gorbenko-Germanov, R. A. Zenkova, and V. E. Chebatarev. Pribory i Tekhn. Eksperim., No. 6, 130-1(Nov.-Dec. 1962). (In Russian)

A IKS-11 spectrometer equipped with a monochromator and automatic recording system UF-302 and capable of recording combined scattering is described. (tr-auth)

23794 RADIATION MONITORS AND INSTRUMENTS. A REPORT ON THE I.A.E.A. CONFERENCE ON NUCLEAR ELECTRONICS, BELGRADE, 1961. D. Taylor (Plessey Nucleonics Ltd., Northampton, Eng.). Proc. Inst. Elec. Engrs., (London), Pt. B, 109: 370-5(Sept. 1962).

The report deals particularly with contamination monitors, survey (dose-rate) meters, and instruments for monitoring gaseous and liquid effluent for radioactive contamination. Among the new techniques mentioned are the following: selective γ-monitoring for portable instruments; the use of semiconductor devices as radiation detectors; impactors for sorting particulate contamination according to the size of the particles; alarm systems taking account of normal natural background variations, so that more rapid variations automatically operate on alarm; the use of Čerenkov detectors in liquid effluent monitoring; the monitoring of surface contamination on fuel elements; the use of coincidence scintillation-counter systems for determining the direction of γ-radiation, for source location; and the remote indication of radiation monitors using telephone lines. The report gives details of a number of new instruments, including a new type of personal radiation monitor, and a new type of instrument for detecting accidental reactor excursions, as well as several new types of plutonium monitors. (auth)

23795 PLUTONIUM MONITORING. D. E. Barnes (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs., (London), Pt. B, 109: 376-9(Sept. 1962).

Monitoring for airborne plutonium presents special problems because the physical and biological properties of plutonium are such that the permissible concentration in air is less than the normal background concentration arising from naturally occurring α-emitters. Because of this difficulty it is desirable to examine the basic health-physics requirements, so as to evaluate the usefulness of the limited information which might be available from relatively simple equipment. The now generally accepted concept of averaging dose over a period of 13 weeks or a year or even longer allows considerable flexibility in operational control, so that the immediate indication of small increases in concentration over the normal level, although it may be very desirable, is not essential, and its value must be weighed against such factors as cost, difficulties in use and interpretation, and the potential loss of reliability of a complex instrument. The various instrumental systems which have been suggested may be divided into three broad classes: (a) direct, in which the plutonium and background radioactive particles are collected and measured together, (b) selective, in which an attempt is made to collect only the plutonium dust, and (c) compensative, in which the background and plutonium dusts are collected together but the counting system is designed to remove the counts due to background before readout. There are inherent difficulties in each of these systems, but several prototype instruments have been made which show promise of a considerable measure of success. (auth)

23796 THE FIRST LIQUID IONIZATION CHAMBER IS A GREAT FRENCH ACCOMPLISHMENT. A. Bérard. Rev. Gen. Electronique, 17: No. 195, 29-33(Feb. 1963). (In French)

A description is given of the fundamentals of operation of ionization chambers, and of the characteristics of the "Silistor," a liquid ionization chamber. The uses of the Silistor in dosimetry and radiometry are discussed. (T.F.H.)

23797 A SECTOR-TYPE DOUBLE FOCUSING BETA-RAY SPECTROMETER. Yoshihiko Tendow and Akira Hashizume. Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 57: 1-6(Mar. 1963). (In English)

The design and construction of a sector-type double focusing beta spectrometer having a mean radius of 10 cm and a deflection angle of 180° are described. The resolution and the gathering power of the spectrometer with the Cs^{137} K-conversion line are 0.58 and 0.22%, respectively. (auth)

23798 THE USE OF SPECIAL IONIZATION CHAMBERS TO MEASURE THE ACTIVITY AND CHECK THE PURITY OF RADIOACTIVE PREPARATIONS. E. S. Trukhmanova and T. S. Afanas'ev. Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 382-9(1960).

The possibility of using an ionization chamber with 4π geometry to measure γ activity in production conditions was investigated. The chamber was found to have a number of advantages over those with external irradiation. It is only slightly dependent on the shape of the preparation,

there is practically no external background, and personnel are exposed to only a low degree of irradiation. To test for impurities it is suggested that a differential ionization chamber with spectral sensitivity should be used. In this type of apparatus, measurement is made on the principle of compensating the current from different parts of the chamber by varying the pressure in one of them. To calibrate the chamber, the compensating pressure must be measured for all possible γ emitters. If the compensating pressure differs from the standard for any preparation, impurities are present. The lowest percentage of impurities in artificially prepared mixtures can be revealed by this means. (Referativnyy zhurnal, Khimiya, No. 24, 1961)

23799 INVESTIGATION OF COSMIC PLASMA WITH TRI-ELECTRODE PROBES. N. I. Ionov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 366-70(Mar. 1963). (In Russian)

A tri-electrode probe method was used for measuring concentrations of positive ions, electron concentration, ion and electron energy distributions, and other plasma parameters. The scheme of the probe is given. The values for positive ion concentrations were identical to those obtained by an electron trap method. However, in the tri-electrode probe method the secondary and photoelectron emissions from the collector were suppressed by the fourth-order antidynatron grid. (R.V.J.)

23800 SELECTIVE MEASUREMENT OF SHORT-LIVED FISSION PRODUCTS IN A GAS FLOW. Jean Goupil and André Roguin (to Commissariat a l'Energie Atomique). U. S. Patent 3,089,032. May 7, 1963. Priority date Dec. 4, 1957, France.

A device is designed for the measurement of short-lived fission products in the coolant from a gas-cooled reactor. The device comprises a decay prechamber, a detection chamber downstream of the prechamber, duct means for passing the gas flow through the prechamber and chamber, scintillation detector means, means for collecting ions in a particular area of the chamber, and valve means for isolating the prechamber and chamber from the duct means. In operation, the ion collecting means and valve means are simultaneously energized, and the resulting detector signal is compared with that before the energization. (D.L.C.)

23801 STABILIZED RADIATION DETECTOR. Serge A. Scherbatskoy. U. S. Patent 3,089,955. May 14, 1963. Filed Aug. 17, 1959.

A scintillation counter is designed with means for automatically compensating for variations in the sensitivity of the photomultiplier tube. The compensating means comprises a second scintillation phosphor, a standard radiation source, and a photoelectric device for controlling the sensitivity of the counter in response to the standard light flashes. (D.L.C.)

23802 JACKETED NEUTRON-FLUX MEASURING GAGE FOR NUCLEAR REACTORS. Karl Janner (to Siemens-Schuckertwerke Aktiengesellschaft). U. S. Patent 3,089,958. May 14, 1963. Priority date Nov. 27, 1957, Germany.

A neutron-flux-measuring gage is designed which minimizes disturbing influences on the measurements due to gamma radiation and/or coupling between several adjacent gages. The gage is embedded in three layers, of which one is a moderator substance of great diffusion length, the second is a reflector substance of small diffusion length, and the third is a strong neutron absorber. The jacketed gage is disposed with a gamma absorber in the interspace between the reactor vessel and the biological shielding. Several embodiments of the gage are described. (D.L.C.)

23803 A SCINTILLATOR FOR β-RADIATION DETECTION OF A γ-BACKGROUND. F. N. Shipitsin, V. A. Kazanskaya, and N. N. Prikhodchenko. Russian Patent 143,480. Oct. 26, 1960.

A scintillator for β-radiation detection on a γ background, which improves the conversion factor for β radiation of high and low energies, and facilitates the process of manufacturing large-size scintillators, is made from a scintillating plastic, over which a thin layer of stilbene is sprayed in a vacuum. (TCO)

ISOTOPE SEPARATION

23804 (CEA-tr-A-1285) SÉPARATION DES ISOTOPES DE LITHIUM PAR ÉCHANGE SUR ZÉOLITHES. (Separation of Lithium Isotopes by Exchange on Zeolites). R. Lindner and T. Berdahl. Translated into French from Z. Elektrochem., 64: 919-22(1960). 18p. (includes original, 3p.).

By progressive treatment of the zeolite "ionac C-100", charged with lithium ions, with an aqueous solution of NaCl, the value of the elementary effect of the exchange separation of Li^6/Li^7 was determined to be $\alpha = 1.0049$. An elution experiment on an Ionac C-100 column gave $\alpha = 1.004$ to 1.005. Analogous tests with $\gamma-Al_2O_3$ led to no numerical determinations because of the complexity of the adsorption mechanism. In this case, column separation also did not give satisfactory results. On account of these facts, the usual adsorption columns do not appear to offer competition to actual methods for the enrichment of lithium isotopes. The chemical methods known at the present for the separation of Li^6/Li^7 are compared. (tr-auth)

23805 (CEA-tr-A-1293) PROCÉDÉ D'EXTRACTION DE DEUTÉRIUM. (Extraction Process for Deuterium). F. Zumstein. Translated into French from German Patent 1,066,554. 14p.

A procedure for the extraction of deuterium from industrial hydrogen by low-temperature rectification is described. It uses reversible heat exchangers, placed before the distillation column, to separate low quantities of residual gaseous impurities in solid form from the hydrogen by cooling to the distillation temperature. The product from the head of the column, after passing through the heat exchanger, is enriched in deuterium by catalytic exchange with water. After separation of this water, the hydrogen is returned in closed circuit to the distillation column through heat exchangers. The closed hydrogen circuit was fed by industrial hydrogen from which the major part of the impurities was removed by liquefaction. (J.S.R.)

23806 THE HYDROGEN ELEMENT AND THE PREPARATION OF HEAVY WATER. J.-T. Jenn and Philippe Akar. Energie Nucl., 5: 98-114(Mar.-Apr. 1963). (In French)

Articles on heavy water production methods are reviewed. Descriptions of the principal processes are given. The position of the "heavy water" question toward the end of 1962 in the light of the latest information on production methods and future uses of deuterium, heavy water, and tritium is stated. (auth)

23807 THEORY OF ISOTOPE SEPARATION OF HOMO AND HETERONUCLEAR DIATOMIC MOLECULES BY ADSORPTION AT LOW TEMPERATURES. A. Katorski and David White (Ohio State Univ., Columbus). J. Chim. Phys., 60: 29-31(Jan.-Feb. 1963). (In English)

The ground-state rotational-vibrational energies, E_T, for diatomic molecules adsorbed on plane surfaces were calculated assuming a Morse potential for the surface-molecule interaction. For the molecular hydrogens it was found that the trend of E_T as a function of surface barrier, both in units of $8\pi^2 I/h^2$, is nearly the same for all isotopes. The correlation diagram for the heteronuclear molecules deviates somewhat from that of the homonuclears, the magnitude of the deviation depending on the shift of the center of mass. (auth)

23808 THE SIMULTANEOUS CONCENTRATION OF THE HEAVY ISOTOPES OF OXYGEN AND NITROGEN BY DISTILLATION OF NITRIC OXIDE AT LOW TEMPERATURES. THE PARAMETER OF SEPARATION OF N^{14}/N^{15} IN THE SYSTEM NO/CH_4. Klaus Clusius, Kuno Schleich, Ulrich Piesbergen, and Eva Varde (Universität, Zurich). J. Chim. Phys., 60: 48-51(Jan.-Feb. 1963). (In French)

Two low-temperature rectification columns for the simultaneous enrichment of the heavy isotopes of nitrogen and oxygen are described. A detailed examination is made of the diagram of state of the NO/CH_4 system at a temperature of 111.2°K. For a molar fraction of CH_4 equal to 0.865, it has a maximum vapor pressure of 786 mm of Hg. The maximum mixing heat is increased to −96.5 cal/mole for $\gamma = 0.5$. For the separation parameter with respect to nitrogen isotopes, the value $\delta = 0.014$ was found, whereas previously a value of 0.031 was measured for pure nitrogen. This fact confirms the hypothesis that the isotopic effects depend largely on association equilibria with the condensate. (tr-auth)

23809 SEPARATION OF ISOTOPES BY GAS AND ION EXCHANGE CHROMATOGRAPHY. Eugen Glueckauf (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Chim. Phys., 60: 73-80(Jan.-Feb. 1963). (In English)

The present position of isotope separation by chromatographic methods is reviewed. The mechanics of column operation, i.e., the influence of theoretical plate height and number, of the separation factor and of the operational conditions such as maintenance of sharp and diffuse fronts respectively, are discussed. From an application point of view there are three cases: (a) gas chromatographic separations of hydrogen isotopes, with large separation factors can easily be achieved, both for analytical and preparative uses; (b) ion exchange separations involving weak-acid or weak-base dissociations in the solution phase, with feasible laboratory-scale separations; and (c) pure ion-exchanger separations, in which the separation factors are too small to give separations which are of more than scientific interest. (auth)

23810 A FUNDAMENTAL STUDY ON THE ION EXCHANGE SEPARATION OF LITHIUM, NITROGEN AND URANIUM ISOTOPES. Hidetake Kakihana (Tokyo Inst. of Tech.). J. Chim. Phys., 60: 81-8(Jan.-Feb. 1963). (In English)

Fundamental equations for the ion exchange separation factor of the isotopes A and B were derived: a) for the system having the molecules or ion associations $\ln S_A^B = \ln K_{A+}^{B+} + \ln {}_A^B K_X - \ln {}_A^B K_Y - \ln\{1 + [{}_A^B K_X - 1/1 + (AX)/(A^+)]\} + \ln\{1 + [{}_A^B K_Y - 1/1 + (AY)/(A^+)]\}$; b) for the system having stepwise series of complexes $\ln S_A^B = \ln {}_A^B K_z + \ln \prod_{z+1}^{n} K_n - \ln \prod_{1}^{s} \overline{K}_s - \ln [\sum_{n=0}^{n} (AX_n)]^{-1} [(A) \prod_{1}^{n} K_n + (AX) \prod_{2}^{n} K_n + \cdots + (AX_z) \prod_{z+1}^{n} K_n + \cdots + (AX_n)] + \ln [\sum_{s=0}^{s} (\overline{AX_z Y_s})]^{-1} [(\overline{AX_z}) \prod_{1}^{s} \overline{K}_s + (\overline{AX_z Y}) \prod_{2}^{s} \overline{K}_s + \cdots + (\overline{AX_z Y_s})]$. According to the prediction based on these fundamental equations, some experimental works were done to obtain larger separation factors for the isotopes Li, N, and U. The results are as follows: Separation factors of 1.005 to 1.008 for Li; 1.027 to 1.029 for N, and 1.00028 to 1.00040 for U. (auth)

23811 THE MACRO SEPARATION OF STABLE ISOTOPES ON ION-EXCHANGE COLUMNS. F. H. Spedding (Ames Lab., Ames, Iowa). J. Chim. Phys., 60: 89-96(Jan.-Feb. 1963). (In English)

The methods of separating macro quantities of stable isotopes on cation exchange columns as developed at Iowa State University are discussed, with particular emphasis on the N^{14}, N^{15} systems. The quantitative theory which permits such variables as the degree of separation, the quantities of chemicals required, and the amount of solution needed, to be calculated in advance, is presented. The theory is rather simple in principle, since it only requires a knowledge of material balance equations and a few experimental facts such as the capacity of the resin, the apparent equilibrium constants of the reactions which are taking place in the column, and the exchange separation factors of the isotopes exchanging in the column. The theory is also applicable to anion-exchange columns for other isotopes. Over one hundred grams of 99.7% N^{15} were separated in the laboratory by these methods. (auth)

23812 CHROMATOGRAPHIC SEPARATION OF THE ISOTOPIC AND NUCLEAR SPIN SPECIES OF THE HYDROGENS AT LOW TEMPERATURES. Walter J. Haubach and David White (Ohio State Univ., Columbus). J. Chim. Phys., 60: 97-9(Jan.-Feb. 1963). (In English)

Several experiments employing the chromatographic technique were performed to determine the relative separation factors of the isotopic and nuclear spin species of the hydrogens. Gamma alumina free from paramagnetic impurities were used as the adsorbent material in the column and the experiments were carried out at 55°K. A comparison is made with theory. (auth)

23813 SEPARATION FACTORS FOR LITHIUM ISOTOPE EXCHANGE ON THE AMBERLITE IR-120 CATION EXCHANGE RESIN. Milan M. Ciric and Jovan D. Pupezin (Inst. of Nuclear Sciences "Boris Kidrich," Belgrade). J. Chim. Phys., 60: 100-4(Jan.-Feb. 1963). (In English)

The effect of concentration on the elementary separation factor for various lithium compounds ($LiNO_3$, LiCl, Li_2SO_4, CH_3COOLi, and LiOH) was investigated using the breakthrough technique on an exchange column. Depending on the concentration and the anion, the separation factors varied from 1.019 to 0.999, Li^7 being enriched in the solution. In cases of the chloride and nitrate solutions distinct maxima at the concentration of 2N (1.019 and 1.014 resp.) were observed. Minima appeared at 3 resp. 4N with factors of 1.007 and 0.999. The solutions of sulfate, acetate, and hydroxide showed factors between 1.0021 and 1.0003 with a less pronounced concentration dependence. Addition of alcohol, glycol, or dioxane to the lithium salt solutions acted in the sense of decreasing the separation parameters. A qualitative explanation is based on ion pair formation. (auth)

23814 SEPARATION OF STABLE ISOTOPES BY CHEMICAL AND ION-EXCHANGE METHODS. G. M. Panchenkov (Moscow State Univ.). J. Chim. Phys., 60: 107-14(Jan.-Feb. 1963). (In English)

Methods are described for separating stable isotopes by the use of various types of molecular compounds. Isotopes of boron, sulfur and oxygen were separated by this method. Isotopic exchange reactions occurred in the electric discharges. Calculations of single stage separation factors for exchange reactions are given. Potentialities of the isotope separation process using ion exchange are discussed. The use of ion exchange for separating lithium isotopes is described. Synthetic zeolites (molecular sieves) were used as ion exchangers. Principles and applications of the continuous countercurrent ion exchange method are outlined. (auth)

23815 SOME FEATURES OF THE DUAL-TEMPERATURE METHOD OF SEPARATION OF HYDROGEN ISOTOPES. S. E. Vaisberg and Ya. M. Varshavskii (Varshavsky) (Inst. of Radiation, Physics, Chemistry, and Biology, Academy of Sciences, Ukrainian SSR). J. Chim. Phys., 60: 115-23(Jan.-Feb. 1963). (In Russian)

The two-temperature isotopic hydrogen exchange between liquid water and countercurrent gas which forms the basis of the most economical method to produce heavy water is effected not between pure substances but between two-component phases: the satured gas solution in water and the gas mixture with saturated water vapors. The effect of the bi-componency of phases on the process of two-temperature isotopic hydrogen exchange was analyzed and equations worked out for the exchange between the gas-vapor mixture and the gas solution when the exchange rate in the solution is sufficiently fast. The enrichment curves were calculated as exemplified by the scheme of the two-temperature exchange in the system water-hydrogen chloride (where the effect of the bi-componency of phases is rather strong). The process of the enrichment of deuterium in this system (hydrochloric acid-gas vapor mixture of hydrogen chloride with water) at $t_1 = 17°C$, $t_2 = 90°C$, $P = 1$ atm was experimentally investigated. It was shown that the bi-componency of phases may lead to a shift of the enrichment maximum beyond the ratio of currents, equal to the value of the distribution coefficient (α) of deuterium. The enrichment maximum in the system under study lies in the range 2.8 to 2.9, whereas the highest value (for a cold column) at 17°C is 2.53. The ratio of the height equivalent to a theoretical plate (HETP) for rectification of water and HETP for the two-temperature exchange was determined and found to be, for the system under study, about 0.4. (auth)

23816 THE HOMOGENEOUS CATALYSIS OF THE ISOTOPE EXCHANGE BETWEEN HYDROGEN AND LIQUID WATER. U. Schindewolf (Kernforschungszentrum, Karlsruhe, Ger. and Technische Hochschule, Allemagne, Ger.). J. Chim. Phys., 60: 124-9(Jan.-Feb. 1963). (In English)

A study was made of hydrogen-water isotope exchange with catalysts of Ru (III) in hydrochloric acid solution, Co (II) in cyanide solutions, and basic solutions (NaOH). The exchange mechanisms were evaluated and the rates compared. (M.C.G.)

23817 DETERMINATION OF THE SEPARATION FACTOR OF DEUTERIUM BETWEEN AMMONIA AND HYDROGEN. Jean Ravoire, Pierre Grandcollot, and Grégoire Dirian (CEN, Saclay, France). J. Chim. Phys., 60: 130-8 (Jan.-Feb. 1963). (In French)

The deuterium separation factors between molecular hydrogen and gaseous ammonia ($\underline{a}_g$) and between molecular hydrogen and liquid ammonia ($\underline{a}_l$) were studied using experimental measurements and calculations from spectrographic data. Relations were established which permit the calculation of $\underline{a}_g$ and $\underline{a}_l$ at different temperatures. The difference of zero energy between NH_3 and NH_2D was deduced. (tr-auth)

23818 KINETICS AND MECHANISM OF THE EXCHANGE OF DEUTERIUM BETWEEN AMMONIA AND HYDROGEN IN THE PRESENCE OF POTASSIUM AMIDE. Grégoire Dirian, Fernande Botter, Jean Ravoire, and Pierre Grandcollot (CEN, Saclay, France). J. Chim. Phys., 60: 139-47(Jan.-Feb. 1963). (In French)

The variation of the velocity of the chemical reaction as a function of the concentration in potassium amide is given by the relation $K = K_1 [NH_2^-] + K_2 [NH_2^-][K^+]$. A mechanism explaining this law is proposed. In general, the mass transfer of the hydrogen in the liquid comes into play, and the

velocity observed is at the $\sqrt{DK}$ proportional limit, where D is the diffusivity of the hydrogen in liquid ammonia, including eventually turbulent diffusion. (tr-auth)

23819 CHEMICAL EXCHANGE REACTIONS FOR THE CONCENTRATION OF NITROGEN AND OXYGEN ISOTOPES. T. I. Taylor (Columbia Univ., New York). J. Chim. Phys., 60: 154-9(Jan.-Feb. 1963). (In English)

The exchange reactions of NO with 10M HNO_3 (α = 1.055) and NO with N_2O_3 (α = 1.031) were used to prepare 99.7% N^{15}. The rapid exchange rate of NO with N_2O_3 resulted in a short plate height (H.E.T.P. = 1.15 cm) so that the separation was achieved in a cascade of two columns with a total length of only 5.5 meters. In the exchange of NO with solutions of nitric acid, O^{18} concentrated in the gas phase (α = 1.02). A reflux system was devised for this system and short columns were successfully operated. An integrated system results in the concentration of N^{15} at one end and O^{18} at the other. Experiments with a number of other exchange reactions for the concentration of O^{18} or N^{15} are described. These include CO_2 with water; CO_2 with amine carbamates; and NO with $CuCl_2$ in methanol. The characteristics of the systems which could be refluxed thermally (exchange-distillation) are of particular interest because of the relative simplicity of their operation and control. (auth)

23820 GENERAL OUTLINE. THERMAL DIFFUSION. Klaus Clusius (Universität, Zurich). J. Chim. Phys., 60: 163-9(Jan.-Feb. 1963). (In French)

The discovery in 1938 of a separation column procedure has permitted preparation in the pure state of different isotopes and created, in a general fashion, a renewal of interest in gas kinetics. Recent developments indicate the mastery attained in the separation of isotopic mixtures with multiple constituents. These works have led to the establishment of a scheme of theoretical relations which permit the advance calculation of the quasi-stationary distribution of different isotopes of isotopic molecules. The practical application possibilities were examined in the case of oxygen and confirmed. The method of auxiliary gas addition has shown itself to have satisfactory utilization by giving the possibility of producing rare isotopes in extremely pure state, such as Ar^{38} and Ne^{21}. Moreover, this system will be very useful in the preparation of O^{17} and S^{34}. One relatively new fact is the knowledge of the effect of the moment of inertia on the thermal diffusion as it was shown for systems of Ar^{40} with the four hydrochloric gases and of Ne^{20} or Ne^{22} with the different methanes. The separation column has found special applications, for example, in the determination of the archeological age by the C^{14} method using Ar^{38}. Finally, the new definition of the meter is based on the possibility of preparing in the pure state the isotope K^{86} in the separation column and of measuring in vacuum the wavelength of its orange ray $5d_5-2p_{10}$ with a precision of $1:10^9$. (tr-auth)

23821 DOES A PRESSURE DEPENDENCE OF THERMAL DIFFUSION EXIST? Gerhard Dickel (Universität, Munich). J. Chim. Phys., 60: 170-1(Jan.-Feb. 1963). (In English)

It is shown that the increasing of thermal unmixing with higher pressures can not be regarded as the pressure dependence of thermal diffusion. (auth)

23822 THERMAL DIFFUSION IN HYDROGEN–HELIUM MIXTURES. C. J. G. Slieker and A. E. de Vries (FOM, Laboratorium voor Massascheiding, Amsterdam). J. Chim. Phys., 60: 172-7(Jan.-Feb. 1963). (In English)

Relative thermal diffusion factors of the binary systems He^4-HT, He^4-DT, and He^4-T_2 were measured in a thermal diffusion column at three temperatures: 325, 355, and 390°K. The experiments show that in this small region a temperature dependence exists, which cannot be explained with the Chapman–Enskog theory. Moreover, the experiments suggest that the diffusion coefficient of the He^4-HT mixture is much smaller than of the He^4-DT and He^4-T_2 systems. (auth)

23823 ISOTOPE ENRICHMENT BY THERMAL DIFFUSION IN FUSED ALKALI NITRATES. Silas Gustafsson (Chalmers Tekniska Högskola, Göteborg). J. Chim. Phys., 60: 183-6(Jan.-Feb. 1963). (In English)

Thermal diffusion was studied in fused nitrates. In the pure salts $LiNO_3$ and $RbNO_3$ the ratios Li^6/Li^7 and Rb^{85}/Rb^{87} were highest on the hot side. The Soret coefficients were found to be 3.3×10^{-5} degrees^{-1} (temperature region 276 to 425°C) and 1.0×10^{-5} degrees^{-1} (335 to 483°C) respectively. A number of mixtures of $LiNO_3$ and $AgNO_3$ were investigated in a thermogravitational column. In a run with 60 mole% $LiNO_3$, a cell height of 9.4 cm, a plate distance of 0.023 cm, and a temperature difference between the plate surfaces of about 29° a separation factor of 1.043 was obtained after 120 hours, with Li^6 enriched at the top. (auth)

23824 THE PHOTOCHEMICAL SEPARATION OF MERCURY ISOTOPES. Harry E. Gunning (Univ. of Alberta, Edmonton). J. Chim. Phys., 60: 197-204(Jan.-Feb. 1963). (In English)

Recent developments in the field of mono-isotopic mercury photosensitization are presented and discussed. By the use of a spatially-intermittent rotating sector, optimum mercury isotope enrichments are obtained in the reaction of hydrogen chloride, and the alkyl chlorides, with mercury isotopes, photo-excited in natural mercury vapor. Results are reported for both Hg^{198} and Hg^{202}-electrodeless discharge sources. It is shown that the isotopically-specific primary process $RCl + {}^1Hg\ 6({}^3P) \rightarrow {}^1HgCl + R$ only occurs if R contains at least one H atom. From an analysis of the overall reaction mechanism, it was concluded that the primary reaction, forming calomel, constitutes at least one-third of the quenching process. From the results on a wide range of calomel-forming substrates, it was concluded that the activated complex in these isotopically-specific reactions is a cyclic structure in which the excited mercury isotopes is simultaneously bonded to chlorine and hydrogen. (auth)

23825 POSSIBLE CONDITIONS FOR ISOTOPIC ENRICHMENT BY A PHOTOCHEMICAL REACTION. René Gilbert (Faculté des Sciences, Nancy). J. Chim. Phys., 60: 205-8(Jan.-Feb. 1963). (In French)

It was shown that illumination of a gas by a ray belonging to its vibration spectra permits molecules to be obtained in which the vibration energy corresponds to a temperature higher than the translation temperature. The excitation of the vibration of a molecule can increase considerably the velocity of a chemical reaction. Therefore, as a result, differences in the reaction velocities of two isotopic molecular varieties can be expected under the effect of a radiation belonging to the vibration-rotation spectrum of the molecule. (tr-auth)

23826 THE NOZZLE SEPARATION PROCESS. Erwin Willy Becker, Konrad Bier, Wilhelm Bier, and Rolf Schuette (Kernforschungszentrum, Karlsruhe; Ger. and Technische Hochschule, Karlsruhe, Ger.). J. Chim. Phys., 60: 212-16 (Jan.-Feb. 1963). (In German)

In the nozzle separation process the addition of a light

gas increases the density of the pressure diffusion current of a heavy isotope mixture which gives rise to a higher separation factor. It is shown experimentally that in a mixture of 10 mole % argon and 90 mole % helium the elementary separation effect of the argon isotopes is higher by a factor of 1.7 as compared with pure argon under the same throughput and cut of the isotopic mixture. The economy of the separation process is also improved by the addition of a light gas although it too has to be processed in the separation cascade. In case of the argon isotopes the addition of 400 mole % helium reduces the specific suction volume to $\frac{1}{3}$, the specific slit length to $\frac{1}{5}$, and the specific compression energy to $\frac{3}{4}$ of the values for pure argon. Preliminary experiments with UF_6/He-mixtures show that also in the separation of the uranium isotopes economic advantages are to be expected from the addition of a lighter gas. (auth)

23827 SELECTIVE EFFECT AND ISOTOPIC ENRICHMENT OBTAINED BY FLAMES IN THE LATERAL DIFFUSION OF MINERAL ELEMENTS INTRODUCED IN SOLUTION. Marcel Servigne and Jean-Louis Siemons (Institut National Agronomique, Paris). J. Chim. Phys., 60: 224-9 (Jan.-Feb. 1963). (In French)

Pulverization in a flame of a mineral salt causes losses of these elements by lateral diffusion outside the crest. The particular study of these lateral diffusers leads to the prediction of some effects. The majority of metallic elements, separately treated under identical conditions, have a specific diffusion coefficient. The process, applied simultaneously to pairs of elements, becomes selective. It causes an enrichment of the diffuser in the lightened particles. The process is very sensitive and can be applied to isotopic enrichment of the natural Li^6–Li^7 couple. Experiments confirm these points and verify, at least qualitatively, the theoretical data of the problem, established in the first approximation. (tr-auth)

23828 APPLICATION OF THE FUSED SALT ELECTROMIGRATION METHOD TO THE SEPARATION OF CALCIUM ISOTOPES. Francis Ménès, Grégoire Dirian, and Etienne Roth (CEN, Saclay, France). J. Chim. Phys., 60: 245-9(Jan.-Feb. 1963). (In French)

The conditions for the prolonged operation of apparatus for the pre-enrichment of Ca^{46} by a fused salt countercurrent electromigration method were studied. It was possible to obtain several tens of grams of calcium enriched in Ca^{46}. (tr-auth)

23829 ISOTOPE SEPARATION BY COUNTERCURRENT ELECTROMIGRATION IN FUSED NITRATE SYSTEMS. Frédéric Lantelme and Marius Chemla (Collège de France, Paris). J. Chim. Phys., 60: 250-3(Jan.-Feb. 1963). (In French)

Countercurrent electromigration experiments in fused $LiNO_3$–KNO_3 and $LiNO_3$–$NaNO_3$ mixtures have shown that the separation of lithium isotopes is normally made following an exponential form. But, contrary to what the difference of mobility of the ions Li^+ and K^+ or Li^+ and Na^+ would predict, the ratios $LiNO_3$–KNO_3 or $LiNO_3/NaNO_3$ vary slightly and attain a plateau. (tr-auth)

23830 ISOTOPE EFFECTS IN SOLID Li_2SO_4 AT 600-790°C. Arnold Lundén (Chalmers Tekniska Högskola, Göteborg). J. Chim. Phys., 60: 259-62(Jan.-Feb. 1963). (In English)

Three different isotope fractionation processes were studied in the same experiment, when solid Li_2SO_4 was electrolyzed in a Vycor cell using a liquid zinc cathode and a gold anode. The main object was to study the enrichment of Li^7 at the anode due to the difference in ion mobility. For this electromigration process the mass effect (i.e. relative difference in ion mobility/relative difference in mass) was $\mu = -0.14$, independent of temperature. The mass effect is thus about the same as in molten lithium halides. The principal difference between electromigration experiments in solid and molten salts is that in the former the salt lattice forms the separation column, which is gradually consumed during the run, while for a melt the hydrostatic forces produce a counterflow which keeps the separation column filled with salt. The two other isotope effects were found for the competing cathode reactions. Thus a lithium–zinc alloy was formed due to a deposition reaction while, simultaneously, reduction reactions gave a mixture of lithium oxide, sulfide, and also some sulfite. As to the deposition reactions, Li^6 was enriched in the alloy with a separation factor of 1.01. The detection of an isotope effect for the reduction reactions was complicated by the fact that the reaction products were thoroughly mixed with remaining sulfate. However, a fraction of the products was insoluble in water, and a significant difference in isotope abundance was established between the soluble and the insoluble material. (auth)

23831 ENRICHMENT OF Rb^{85} AND Rb^{87} ISOTOPES BY ELECTROMIGRATION IN AQUEOUS SOLUTION. Klaus Clusius, Max Huber, and Klaus Wagener (Universität, Zurich). J. Chim. Phys., 60: 263-4(Jan.-Feb. 1963). (In French)

A solution of rubidium acetate is electrolyzed in a 2-liter cell with a field intensity of 20 v/cm. The cell, constructed in the manner of a filter press, is composed of 50 1-cm-long cooled chambers, separated by nylon ribbons serving as diaphragms. The electrolyte of 0.5N acetic acid is introduced at the cathode end, whereas at the anode end the pure acetic acid flows out. The ratio of the mobility of the Rb ions at 16°C is 1.0008. The efficiency of the cell is 1400 ideal plateaus. By operating the cell without additional input, the Rb^{87} is impoverished at the cathode up to 17.4% and at the anode it is enriched to 39.2%. The natural concentration rises to 27.2%. (tr-auth)

23832 ISOTOPE SEPARATION BY GASEOUS DIFFUSION. Daniel Massignon (CEN, Saclay, France). J. Chim. Phys., 60: 267-76(Jan.-Feb. 1963). (In French)

The problem posed by isotope separation by gaseous diffusion, passing through a porous wall, is described. The separation yields of one barrier and one diffusion cell are discussed. The recent principal works in this region are reviewed. (tr-auth)

23833 ISOTOPIC ENRICHMENT OF THE MIXTURE H_2O–DHO BY RELEASE IN ADSORBED PHASE. Charles Eyraud, Jean-Claude Sapet, and Charles Daneyrolle (Faculté des Sciences, Lyon and Institut National des Sciences Appliquées, Lyon). J. Chim. Phys., 60: 285-8(Jan.-Feb. 1963). (In French)

The structure and thermodynamic properties of an adsorbent are characteristics that depend not only on the nature of the substrate and the vapor, but also on the covering rate of the solid surface and on the temperature. Before outlining a general theory on the dynamics of a vapor in a microporous body, it is necessary to imagine and to realize a certain number of tests whose results can orient the selection of basic hypotheses. One of the essential experimental conditions resides in the use, between the capillary extremities, of finite differences as small as possible ($\Delta p, \Delta T$) of the state variable controlling the release. Moreover, the judicious choice of a binary vapor mixture can give complementary information on the mecha-

nism of the surface diffusion. One of the mixtures studied was H_2O-DHO. It was established that, according to the values of the relative pressure, the separation efficiency passes through two maxima and one minimum. (tr-auth)

23834 IMPROVEMENT OF THE EFFICIENCY OF ISOTOPE SEPARATION BY GASEOUS DIFFUSION THROUGH A POROUS WALL BY USING ELECTRIC FIELDS. Jacques Verdier, Louis Weil, and Henri Morin (CEN, Grenoble). J. Chim. Phys., 60: 289-93(Jan.-Feb. 1963). (In French)

The possibility of improving the separation coefficients of isotope separation in gaseous diffusion through a porous wall was investigated by using high electric fields permitting the creation of an electric discharge of the corona effect type in the gas discharge jet. Experiments were made with argon, and the enrichment coefficients of Ar^{36} in natural Ar were measured. They showed, in particular, that the efficiency of separation can be increased 50% in a stage where the partition coefficient of the flux was 0.5. This improvement was due to the partial destruction of the limiting boundary in the vicinity of the porous wall, a destruction consecutive to the turbulences that originate from the corona discharge. (tr-auth)

23835 THEORY OF THE SEPARATION OF ISOTOPES BY GASEOUS DIFFUSION THROUGH A PILE OF SPHERES. Jean-Paul Breton and Daniel Massignon (CEN, Saclay, France). J. Chim. Phys., 60: 294-303(Jan.-Feb. 1963). (In French)

The present theories of the separation by a porous wall are all based on the model of strongly elongated cylindrical capillary pores. The present theory substitutes for this model that of a disordered and isotropic pile of identical spheres. This describes in a more correct fashion the real texture of porous media. The separation yield obtained is compared to that of a capillary. (tr-auth)

23836 ISOTOPIC EXCHANGE OF OXYGEN AND MECHANISM OF PHASE TRANSFORMATIONS IN SILICATES. Jeannine Fructus-Riquebourg and Henri Merigoux (Faculté des Sciences, Paris and CEN, Saclay, France). J. Chim. Phys., 60: 351-4(Jan.-Feb. 1963). (In French)

The study of the isotopic exchange of oxygen between samples of vitreous and crystallized silicates and of water enriched in O^{18} showed that this exchange exists when there is no phase transformation and that it is increased if a phase transformation occurs. Some experiments made between an enriched silicate and dry CO_2 or in the presence of water have shown the effect of water on the rate of exchange. The results of these experiments can be interpreted by the hypothesis of a reaction mechanism of water on silicates: the H^+ and OH^- ions break the bonds Si-O-Si and Al-O-Si. (tr-auth)

23837 ISOTOPE EXCHANGE OF THE OXYGEN ATOMS IN MOLECULAR SIEVE ADSORBENTS WITH WATER AND CARBON DIOXIDE. S. C. Saxena and T. I. Taylor (Columbia Univ., New York). J. Inorg. Nucl. Chem., 25: 261-70 (Apr. 1963).

The use of molecular sieve adsorbents for the continuous recovery of H_2O^{18} from the gas stream of an isotope separation system is complicated by the exchange of oxygen atoms between the water and the adsorbents. The 75 per cent of the oxygen atoms in the molecular sieve adsorbents exchange with H_2O^{18} in 2 hr at 250°C. At 135°C, only 24 per cent of the oxygen atoms exchange in 64 hr, and at room temperature the exchange is very slow. Carbon dioxide exchanges with about the same fraction of oxygen atoms in the molecular sieve adsorbents as water does. This exchange probably occurs through small quantities of water vapor since, after prolonged drying under high vacuum at 250°C, the rate of exchange with carbon dioxide is somewhat slower. Oxygen gas does not exchange at 250°C with molecular sieve adsorbents in the presence or absence of water vapor. (auth)

23838 THE PREPARATION OF ^{210}Bi BY A SZILARD-CHALMERS REACTION. D. S. Popplewell (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inorg. Nucl. Chem., 25: 318-20(Apr. 1963).

Results are reported for the yields and enrichment factors in the production of carrier-free Bi^{210} from irradiated triphenyl bismuth and triphenyl bismuth dichloride. Solvent extraction and retention on a zinc reductor column were used to separate the Bi^{210}. Enrichment factors of up to 840 were obtained, and the best method of preparing enriched Bi^{210} was from pure triphenyl bismuth using ammonical 2% disodium salt of EDTA as aqueous extractant. (D.L.C.)

23839 FUNDAMENTAL STUDIES ON THE ION EXCHANGE SEPARATION OF ISOTOPES. VI. THEORETICAL CONSIDERATION FOR ION EXCHANGE SEPARATION FACTORS OF ISOTOPES. Hidetake Kakihana and Kimiko Kurisu (Tokyo Inst. of Tech.). Nippon Genshiryoku Gakkaishi, 5: 292-9(Apr. 1963). (In Japanese)

Ion exchange separation factors for the quaternary valence isotopes (A) forming stepwise complexes (AX_n) in external solutions were theoretically evaluated. Two forms of the limits for the separation factors were found both for the anion exchanger and the cation exchanger systems. For the anion exchanger, (1) $\lim \Delta = \lim (\ln S_8^A - \ln \beta_8^A K_8) = -(\prod_{m+1}^{5} K_n - 1)$, (2) $\lim \Delta = -\epsilon/6$, $\lim \Delta = -(\epsilon - \prod_{m+1}^{5} K_n + 1)/5$, $\lim \Delta = -\{\epsilon - (\prod_{m+1}^{5} K_n - 1) - (\prod_{q+1}^{5} K_n - 1)\}/4$. For the cation exchanger, (1) $\lim \Delta = -(\prod_{1}^{m} K - 1)$, (2) $\lim \Delta - \epsilon/6$, $\lim \Delta = -(\epsilon - \prod_{1}^{m} K_n + 1)/5$, $\lim \Delta = -\{\epsilon - (\prod_{1}^{m} K - 1) - (\prod_{1}^{q} K - 1)\}/4$. On the anion exchanger system, in the case of only AX_5 being adsorbed on and the very large excess of A existing in the external solution, the effect by five times as large as the ratio of the stability constants of one step complex formation is expected on the separation factor. On the cation exchanger, the highest effect is expected when only A is adsorbed on and the very large excess of AX_8 exists in the external solution. The value for the effect is approximately six times as large as the ratio of the stability constants of one step complex formation. (auth)

23840 ISOTOPIC FRACTIONATION OF CARBON BY MOLECULAR DISTILLATION. Ryohei Nakane and Toshiyuki Ohyama. Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 57: 7-9(Mar. 1963). (In English)

C^{13} is concentrated by molecular distillation of methyl alcohol at −95°C. The apparatus used is a Dewar vessel type still consisting of two glass vessels, one within the other. Methyl alcohol evaporates in the outer vessel and freezes on the chilled inner vessel. The distillation is operated with various cuts from 8 to 145 and the enrichment factor from 1.022 to 1.048 yielding concentrated C^{13} in the residue. On the assumption that the vapor pressures of isotopic methyl alcohols are the same, the single-stage separation factor is determined to be 1.010 and the efficiency about 60%. (auth)

MATHEMATICS AND COMPUTERS

23841 (AERE-R-4285) INTERASP—AN INTERMEDIATE ATLAS SYMBOLIC PROGRAMMING LANGUAGE. R. C. F. McLatchie and I. C. Pyle (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1963. 36p.

INTERASP is a symbolic machine language for the ATLAS computer. An assembly program, IASP, written in FORTRAN and executed on an IBM 7090, which translates the INTERASP language of a routine into basic machine orders for ATLAS, is described. The results of the IASP translation, like those of the ATLAS FORTRAN compiler, are punched on relocatable binary cards in the standard BAS format. Those parts of a job for which FORTRAN is not suitable may therefore be coded as routines in INTERASP, assembled by IASP, and—compiler and assembler output being compatible—the translated routines for the whole job may then be read into ATLAS by the same standard loader program. Flexible intercommunication between FORTRAN and INTERASP routines during the subsequent execution phase on ATLAS, facilitated by their having a common target language (BAS), is ensured by means of the arrangements for sharing storage areas that can be made in INTERASP, and by observing in the INTERASP routines the FORTRAN calling sequence conventions described in this report. (auth)

23842 (CRT-1148) APEX-III: AN ALGEBRAIC COMPILER FOR THE G-20 COMPUTER. J. M. Kennedy, E. A. Okazaki, and J. K. Fowler (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1963. 57p. (AECL-1728)

APEX is an ALGOL-like algebraic language for writing computer programs. APEX-III, the version of APEX that is used on the A.E.C.L. G-20 computer is described. The expanded language allows a number of declarations and operations that were not available in the original APEX. (auth)

23843 (JINR-P-1228) MINIMIZATSIYA FUNKTSII MNOGIKH PEREMENNYKH METODOM SOPRYAZHENNYKH PRYAMYKH. (Minimization of Functions of Many Variables by the Method of Conjugate Straight Lines). I. N. Silin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1963. 10p.

A method is proposed to minimize functions of several variables yielding the minimum of the square function in a finite number of iterations. It is effective enough for arbitrary smooth functions and allows establishment of the behavior of the function in the quasi-quadratic neighborhood of its minimum. (auth)

23844 (LADC-5460) REGULA FALSI FOR TWO VARIABLES. W. A. Beyer (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract W-7405-eng-36. 20p.

The convergence of Gauss' generalization of the secant method (regula falsi) to two nonlinear equations in two unknowns is examined. The generalization is modified to insure convergence. The triplets of points used at the nth iteration is kept "bounded" away from colinearity, and it is shown that the Gauss generalization can be written in the form $x^{n+1} = x^n - T_n^{-1} f(x^n)$, where T_n^{-1} is approximately $[f'(x^n)]^{-1}$ with f' denoting the Jacobian matrix. Proofs of the theorems are given to make the generalization to n equations in n unknowns easier. (auth)

23845 (LADC-5465) REGULA FALSI FOR COMPLEX VARIABLES. W. A. Beyer (Los Alamos Scientific Lab., N. Mex.). 1962. Contract W-7405-eng-36. 10p.

The method of regula falsi (a numerical method of calculating a solution of an algebraic equation in one unknown) is generalized to complex functions of complex variables. Convergence is shown in those cases where the complex function does not "deviate" too much from an analytic function. (auth)

23846 (LADC-5484) A NOTE ON MULTIPLE MINIMA IN LEAST SQUARES. Roger H. Moore (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 13p.

Concepts for statistical models are developed, and a theorem to classify a group of models that leads to several least squares solutions is proved. Under the related conditions it is shown that there are m! vectors (points) for which the sum of squares is minimized. The theorem implies the existence of local maxima and saddle points when two or more minima appear. (D.C.W.)

23847 (ORNL-3430) A COMPARISON OF SEVERAL METHODS FOR INVERTING LARGE SYMMETRIC POSITIVE DEFINITE MATRICES. M. H. Lietzke, R. W. Stoughton, and Marjorie P. Lietzke (Oak Ridge National Lab., Tenn.). May 13, 1963. Contract W-7405-eng-26. 34p.

The Gauss-Jordan, Choleski, congruent transformation, and rank annihilation methods for inverting large symmetric positive definite matrices were compared. An attempt was made to consider the effects of both condition and order of the matrix to be inverted on the closeness of the computed inverse to the exact inverse. Each method was programmed in FORTRAN using only single precision arithmetic. Then the error indicators were computed using double precision arithmetic so that the latter calculation was not a limiting factor. It was found that any one of the methods is satisfactory for a well-conditioned least squares matrix of order 10-30. However, when the matrix becomes ill-conditioned then the Gauss-Jordan method appears to be clearly superior (at least for the matrices studied). Algorithms and FORTRAN subroutines for each method are presented. (auth)

23848 (ORNL-TM-553) AUTOMATIC CURVE PLOTTING OF PILOT PLANT PROCESS DATA. E. C. Moncrief (Oak Ridge National Lab., Tenn.). May 13, 1963. Contract W-7405-eng-26. 12p.

Instructions and sample data sheets are presented for automatic curve plotting of pilot plant process data using the CASPER (Calcomp Automatic Scaling, Plotting, Editing Routine) routine on the IBM 7090. However, it is scheduled to be recompiled for use on the new CDC 1604-A computer at ORNL. A special feature of the routine is the option of plotting data from punched cards. (P.C.H.)

23849 (SCR-607) FACTORS FOR ONE-SIDED TOLERANCE LIMITS AND FOR VARIABLES SAMPLING PLANS. D. B. Owen (Sandia Corp., Albuquerque, N. Mex.). Mar. 1963. Contract AT(20-1)-789. 412p.

Tables are given of a quantity k that is used to define single-sample variables sampling plans and one-sided tolerance limits for a normal distribution. The probability is γ that at least a proportion P of a normal population is below $\bar{x} + ks$, where $\bar{x}$ has a normal distribution with mean μ and variance σ^2/n and fs^2/σ^2 has a chi-square distribution

with f degrees of freedom. The quantity k just described corresponds to a percentage point of the noncentral t-distribution and is extensively tabulated. Tabulations of other functions computed from the noncentral t-distribution and various expected values are also given. Many other applications are discussed and various approximations compared. One section gives the mathematical derivations and there is an extensive bibliography that was cross referenced to several indices of mathematical and statistical literature. 82 references. (auth)

23850 (TID-18620) OR-BL1, SUBROUTINE PACKAGE FOR PRODUCING CONTROL TAPES FOR BENSON-LEHNER PLOTTER. G. B. Knight (Oak Ridge Gaseous Diffusion Plant, Tenn.). Mar. 13, 1963. Includes ADDENDA TO OR-BL1 SUBROUTINE PACKAGE. Apr. 15, 1963. Contract [W-7405-eng-26]. 14p.

The subroutine package OR-BL1 that produces control tapes for the Benson-Lehner electrochemical x-y plotter, controllable by magnetic tapes in IBM-BCD format, is discussed. Functions controlled by the tapes are described along with the nature of the subroutines and control tapes. (D.C.W.)

23851 (TID-18629) TECHNICAL PROGRESS REPORT. PART I. HIGH-SPEED COMPUTER PROGRAM. PART II. ILLIAC II SYSTEM PROGRAMMING AND OPERATING. PART III. CIRCUIT RESEARCH PROGRAM. PART IV. MATHEMATICS. PART V. IBM 7090-1401 SYSTEM. PART VI. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Mar. 1963. Contract AT(11-1)-415. 44p.

Work on the high-speed computer program involved component testing, construction and use of a switching time test rig for evaluation of 2N1072's and possible replacement types, modification and testing of the magnetic drum serial 129, modification of driver circuits to overcome power system noise generation, modification to the +65-volt distribution system and the sensing transformer of the core memory (splitting the +65-volt supply into x-y and sense amplifier sections showed the sense amplifiers to be the most sensitive), and design of the cabling arrangement for the 1401. For the ILLIAC II system, a double-precision decimal read routine for Pass 1 of the assembler was written; a subroutine for calculating $\log_{10}x$, $\log_e x$, and $\log_2 x$ was written; four library programs for the card operating system were checked out; the three basic passes of the card assembler were completed and checked; and all four tape units for the 1401 processing system were put into operation. Investigation of the experimental and theoretical aspects of the avalanche breakdown of transistors was initiated. Collector characteristics were examined by using very short pulses to eliminate thermal runaway. Tenative mechanisms were advanced to explain the observed $I_c = {}_mI_E + MI_{co}$ relation. The performance of the T-line system was studied with several 5 ma tunnel-diodes. An input/output impedance ratio of better than two with a voltage gain approaching one up to 1 kmc was achieved. These experiments show that tunnel diode systems using power amplifiers of high directivity and without reflection to the input can be built. A program for investigating the stability behavior of different amplifier types was written for the 7090. Measurements of flip flop performance were completed; experimental figures agreed well with phase-plane theory. A new Mersenne prime M_{9689}, having 2917 decimal digits, was discovered by ILLIAC II. Two new routines; Floating Point Factorial (FORTRAN, MAD, SCAT) and FORTRAN Axes and Point Plotter; were added to the 7090 library. Forty-two research problems, specifications of which were submitted for IBM 7090 programming, are described; and IBM 1401 and IBM 7090 use is summarized. (D.C.W.)

23852 (TRG-Report-198(Suppl.1)) COMPUTER PROGRAMME DISCOUNT — FOR ESTIMATING COSTS OF ELECTRICITY AND PRICES OF PLUTONIUM FROM NUCLEAR POWER SYSTEMS. Supplement 1. C. E. Iliffe (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). Mar. 11, 1963. 11p.

Improvements in version B of the DISCOUNT computer program for estimating costs of electricity and prices of plutonium from nuclear power plants are described. The improvements resulted in changing the version to C. The first improvement is in the calculation of actual equilibrium delay time and the second in the provision of additional input data governing the transfer of plutonium from capacity withdrawn. The changes from version B to C are pointed out with respect to the two programs. (N.W.R.)

23853 (UCRL-10744) CONDITIONS FOR THE DISCRETENESS OF THE SPECTRUM OF SINGULAR ELLIPTIC OPERATORS (thesis). Harold Hanerfeld (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1963. Contract W-7405-eng-48. 47p.

The Direchlet problem for singular second order elliptic operators is examined. Such an operator is defined and extended to a closed, densely defined, Direchlet operator L with a resolvent set contained in a left half-plane. After obtaining L, criteria are formulated for the discreteness of the spectrum of L, and a corollary to the discreteness theorem developed is proved. Criteria for nondiscreteness in a special case are also derived, and positive lower bounds for the least eigenvalue of a positive definite hermitian matrix are developed. (auth)

23854 (WAPD-TM-365) BETTIS FORTRAN PROGRAMMING: AUXILIARY SUBROUTINES. O. J. Marlowe (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1963. Contract AT(11-1)-Gen-14. 85p.

Extensions to the FORTRAN language in the areas of storage allocation including the use of auxiliary storage, input data format and processing, and operating system requirements are discussed. Detailed descriptions of the machine-language subroutines representing these extensions are given along with a general description of the subroutine packages and their use. (auth)

23855 (WCAP-3704) "THINC." A THERMAL HYDRODYNAMIC INTERACTION CODE FOR A SEMI-OPEN OR CLOSED CHANNEL CORE. W. Zernik, H. B. Currin, E. Elyash, and G. Previti (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Feb. 1962. Contract AT(30-1)-3064. 67p.

A steady-state thermal hydraulic interaction code THINC was programed in FORTRAN for the IBM-7090 digital computer in order to calculate the density, velocity, and pressure distribution in a semi-open or closed channel core. The effects of boiling on the axial and transverse flow are included within the limitations of current engineering correlations. The spatial distribution of heat generation is required as input. (auth)

23856 (WCAP-3722(Vol.I)) A DIGITAL COMPUTER ANALYSIS OF CLOSED CYCLE WATER NUCLEAR POWER PLANT START-UP USING NATURAL CIRCULATION (THERMO-SYPHON CODE). VOLUME I. A. N. Nahavandi, B. H. Axelson, G. B. Killinger, and A. H. Killinger (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Feb. 1962. Contract AT(30-1)-3064. 72p.

An analysis of the natural circulation in the primary

system of a closed cycle water nuclear power plant during plant start up is presented. The solution to the problem is obtained by numerical integration of the governing differential equations, using an IBM-7090 digital computer. The thermodynamic behavior of the primary system coolant during plant startup with natural circulation is investigated. Coolant mass flow rate and thermodynamic properties, together with the average fuel temperature, are determined as functions of time. Under the simplifying assumptions, the present analysis and digital program can also be applied to the solution of such primary system transient problems as the system response due to power unbalance. This study is also helpful in determining the system behavior during a total loss-of-flow accident, and the performance of the plant with natural circulation. (auth)

23857 (WCAP-3722(Vol.II) A DIGITAL COMPUTER ANALYSIS OF CLOSED CYCLE WATER NUCLEAR POWER PLANT START-UP USING NATURAL CIRCULATION (THERMO-SYPHON CODE). VOLUME II. A. N. Nahavandi, B. H. Axelson, G. B. Killinger, and A. H. Killinger (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Feb. 1962. Contract AT(30-1)-3064. 202p.

Input data forms, FORTRAN source program listings, and output data sheet samples are presented for the Thermo-Syphon code which analyzes the closed-cycle water nuclear power plant startup using natural circulation. The code is analyzed on an IBM 7090 digital computer. (N.W.R.)

23858 LIE ALGEBRAIC SOLUTION OF LINEAR DIFFERENTIAL EQUATIONS. James Wei and Edward Norman (Socony Mobil Oil Co., Inc., Paulsboro, N. J.). J. Math. Phys. (N. Y.), 4: 575-81(Apr. 1963).

The solution U(t) to the linear differential equation $dU/dt = h(t)U$ can be represented by a finite product of exponential operators; in many interesting cases the representation is global. $U(t) = \exp[g_1(t)H_1] \exp[g_2(t)H_2] \ldots \exp[g_n(t)H_n]$ where $g_i(t)$ are scalar functions and H_i are constant operators. The number, n, of terms in this expansion is equal to the dimension of the Lie algebra generated by H(t). Each term in this product has time-independent eigenvectors. Some applications of this solution to physical problems are given. (auth)

23859 STUDIES IN POTENTIAL THEORY. Hans Wallin. Thesis, Uppsala, Uppsala Univ., 1963. 7p.

The equilibrium and capacitary distributions of a compact set of continuous functions are investigated in an m-dimensional Euclidean space. The K-potential of these distributions is determined by a non-increasing function K, defined in the interval $r \geq 0$, continuous in the interval $r > 0$ and satisfying $K(r) \to K(0) \leq \infty$ when $r \to 0$. (C.E.S.)

23860 COMPUTERS. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). Feb. 1963. 37p. (SB-472(Suppl.1)) $0.10(OTS).

Approximately 800 references are given to Reports and U. S. and foreign journals published from January 1956 through 1962. (P.C.H.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

23861 (AD-282505) MODULE IMPROVEMENT PROGRAM. Progress Report No. 3. (Westinghouse Electric Corp., Pittsburgh) Mar. 15, 1962. Contract NObs-84329. 175p.

Thorough examination of materials for use as core coatings is narrowed to inorganic oxides, both in sheet form and in the form of plasma-sprayed films. Exploratory investigations are made on porcelains and evaporated films of silicon monoxide. Gallium–indium liquid alloy is effective in reducing the thermal drop at the alumina–thermoelectric strap interface after 2600 hr/325°C plus 3300 hr/350°C in air. However, at 510°C in air, it loses effectiveness after a few hundred hours. Under these conditions it reacts with most metals and with oxygen. The development work on core coatings has resulted in materials and application methods that are giving reasonable performance in terms of dielectric strength, temperature drop, and life. Mechanical properties of the power generation materials ZnSb, PbTe, and GeBiTe are measured. A stress analysis for thermoelectric pellets and couples operating in a temperature gradient is made. When this analysis is viewed from life-test results under both static and cyclic conditions, and from mechanical properties of the materials, the past life-performance characteristics are more clear. An adequate encapsulation for GeBiTe is developed. This coating is thin, continuous, and maintains its structure due to its excellent adherence to the GeBiTe. A promising encapsulation is developed for PbTe. The adherence of this composition is superior to any other, and, when used in conjunction with the encapsulation for GeBiTe, gives a thin continuous coating. (auth)

23862 (AD-286036) A STUDY OF FERROELECTRIC MATERIALS. Final Technical Report, September 1, 1961 to August 31, 1962. W. H. Taylor (Cambridge Univ., England. Cavendish Lab.). Sept. 25, 1962. Contract DA-91-591-EUC-1925. 18p.

The high-temperature structures of $NaNbO_3$, radiation effects in ferroelectric materials, and neutron scattering with certain hydrogenous materials and materials showing dielectric anomalies are being studied. For the study of the structure at high temperatures methods were developed for obtaining x-ray single-crystal photographs up to 900°C. At 540°C a tetragonal perovskite-type structure was confirmed. The super lattice reflections associated with 2- and 4- subcell repeats were found at lower temperatures. A ferroelectric material, on irradiation by neutrons, gamma rays, or x rays, acts as a source of electrical energy. Two types of this radiation sensitivity were observed: one variable and of short time-constant, seen for periods of seconds or minutes after the start of irradiation; the other of long time-constant and stable for months after irradiation. Attempts to correlate radiation sensitivity and thickness of sample were unsuccessful. The neutron spectra of ferroelectric and paraelectric $BaTiO_3$, and of a number of hydrogen-bonded structures, were studied and partially interpreted. Evidence was obtained for the existence of a dielectric anomaly at about 20°K in TlCl and 50°K in TlBr. (auth)

23863 (AFCRL-63-36) THE PREPARATION OF HIGH PURITY RARE EARTH METALS BY ZONE REFINING. Final Report, January 1, 1962–January 31, 1963. C. J. Heinink (Research Chemicals. Div. of Nuclear Corp. of America, Phoenix, Ariz.). Contract AF19(604)-7491. 37p.

Attempts were made to prepare the rare earth metals, Sm, Eu, and Gd with total impurities of less than 0.1 ppm. Methods of separation, reduction, and purification were: ion exchange, dry fluoride preparation, metallothermic reduction, vacuum distillation, zone refining by induction heat, and electron beam melting. Gas chromatography was investigated as an analytical tool for determination of oxygen in metals. (P.C.H.)

23864 (BMI-1619(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING FEBRUARY 1963. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Mar. 1, 1963. Contract W-7405-eng-92. 85p.

Research and development progress is reported on reactor materials and components, reactor fuels and fuel elements, radioisotope and radiation applications, tracer system for in-place filter evaluation, coated-particle fuel materials, corrosion of the fluoride-volatility process, creep-rupture of SAP alloys, fission product deposition, irradiation testing, gas-cooled reactor program, properties of F-48 niobium alloy, and joining of regenerative cell components. (N.W.R.)

23865 (GEAP-4139) SPECIFIC ZIRCONIUM ALLOY DESIGN PROGRAM. Quarterly Progress Report No. 3, January 1, 1963. H. H. Klepfer, D. W. Gaylor, K. C. Antony, W. B. Nelson, D. L. Douglass, and J. S. Armijo (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Work Performed under United States–Euratom Joint Research and Development Program. Contract AT (04-3)-189. 60p. (EURAEC-529)

A summary of the findings of the fabrication study and final chemical analysis of the Zr alloys are reported. The corrosion testing of the coupons at 300, 400, and 500°C reached 1125 hr exposure weighing. Gross trends observed thus far are reported. Mechanical testing of all alloys as-fabricated was completed. A mathematical model was derived describing the room temperature mechanical properties of the alloys in the chosen alloy field. Post-corrosion exposure mechanical property testing and hydrogen analyses have begun. The experiment is designed to permit analysis of the final results employing computer programing to determine the optimum composition within the selected alloy field. The results of studies of the partitioning of alloying elements in the corrosion oxide film are presented. Progress on the study of oxygen diffusion in alloy doped nonstoichiometric ZrO_2 is also reported. (P.C.H.)

23866 (HW-76300) CERAMICS RESEARCH AND DEVELOPMENT OPERATION QUARTERLY REPORT, OCTOBER–DECEMBER 1962. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Contract AT(45-1)-1350. 124p.

Pu_2S_3 melted congruently at 1725 ± 10°C under vacuum or argon and was stable to 2300°C in argon. Pu_2S_3 was not attacked by boiling, demineralized water. PuN melted congruently at 2750 ± 75°C under nitrogen (1 atm), but dissociated at 2600° under argon or helium. Plutonium carbides and oxides of various compositions were formed by inert

gas sintering of pressed mixtures of PuO_2 and graphite powder. Spontaneous lattice expansion of PuC at about 0.02% per month occurred over periods extending to 15 months, with no apparent saturation. PuO_2 and MgO were immiscible in all proportions and form no compounds stable at room temperature. ThO_2 was soluble in UO_2 in all proportions, although the solution was not ideal as shown by minima in both melting point versus composition and lattice parameter versus composition curves. Small additions of PuO_2 enhanced the sinterability of ThO_2. Melting points of $(Th,Pu)O_2$ solid solutions were constant below 25 wt % ThO_2. Lattice parameters of the solid solution obeyed Vegard's law. A series of tungsten-UO_2 cermets was fabricated by high-energy-rate impaction. The tungsten matrix was uniform and continuous at UO_2 concentrations as great as 50 wt %. A 50 wt % uranium mononitride-tungsten cermet was fabricated by impaction. The impacted density, 16.3 g/cm^3, was 99.0% of the theoretical density. Uranium monosulfide impacted to 99% TD showed improvements in physical properties over sintered US. A UO_2–50 wt % cermet was examined at temperatures to 1500°C by reflection electron microscopy. The effects of variations in sintering rate, time, and temperature on the microstructure of the sintered UO_2 are illustrated in a series of photomicrographs. An equation relating the specific volume of UO_2 to temperatures between zero and 3100°C was derived. UO_2 heated to 3100°C in closed tungsten capsules retained an O/U ratio of 2.00 and reacted little with the tungsten. Random distribution of 1 vol % tungsten shot (–100 + 200 mesh) in sintered UO_2 was achieved. Hardness of a (100) crystal face of UO_2 showed four-fold rotational symmetry. The (100) plane was identified as the only active slip plane at room temperature. Gas desorption equivalent to 900°C vacuum annealing was obtained by vacuum irradiation of UO_2 at room temperature in a Co^{60} gamma field of 8.9×10^5 R/hr. The reliability of analytical techniques for commercially fused UO_2 was evaluated by checking the vendor's results for density, stoichiometry, and carbon and nitrogen content. Development of a more precise measurement of the contact angle between mercury and UO_2 yielded a 30% correction in pore size determination. UO_2 single crystals of various shapes were prepared for sites in Germany, France, and the United States. Specimens examined by reflection electron microscopy were heated to temperatures greater than 1400°C with an auxiliary electron gun. Urania–2.5 wt % plutonia power was densified by impact, using a hooded Dynapak machine, to provide a ceramic material suitable for fuel in vibrationally compacted fuel elements. A one-foot-long fuel element designed to test the feasibility of fuel rejuvenation was fabricated and sent to NRTS for irradiation. UO_2 rods clad in thin stainless steel were fabricated by swaging and hot isostatic pressing. Transverse excitation applied to the top of vertically suspended cladding simplified coupling of vibrational energy to thin-wall cladding tubes. Higher densities achievable by vibrational compaction at elevated temperatures are directly related to the thermal expansion characteristics of the cladding and core materials. Fabrication of UO_2–PuO_2 fuel elements for a full PRTR core loading proceeded on schedule. Forty-two elements were produced, and successful operation was demonstrated to a maximum exposure of 600 Mwd/ton at tube powers up to 1150 kw. To minimize plutonium segregation in mixed-oxide fuel rods, the number of increments loaded in a rod was doubled. A process for continuous fuel loading is being developed. Preliminary investigation of nondestructive tests for determining segregation revealed two promising methods. A program was initiated to irradiate plutonium fuel elements in the Experimental Boiling Water Reactor. Fuel criteria were established and material procurement initiated. Design of a facility for vibrational compaction of the material is in progress. A roll-cladding process developed for Zircaloy-clad, Pu-Zr fuel elements eliminates external contamination. Special fuel fabrication activities included completion of 219 Al-Pu rods and 40 flux monitor foils for physics tests, 33% completion of 1000 Pu-Al rods for physics tests, development of a process to make depleted UO_2–0.90 wt % PuO_2 pellets of 91 to 94 percent theoretical density for physics experiments, casting and partial extrusion of 14 Al–8 wt % Pu–2 wt % Ni billets for corrosion test fuel elements, and fabrication of 71 Al-clad, coextruded, thin-walled tubular fuel elements containing Al-Pu and Al-U^{235} alloy cores. Laboratory facilities for UO_2 powder preparation were modified. Postirradiation examination of a failed 2.33-inch diameter fuel rod revealed evidence of a severe transverse flux gradient, reduction of coolant flow, and bowing of the rod. Short-term irradiation of high-energy-rate impact formed 50 wt % UO_2-W cermet produced no reaction between the components. UO_2 sublimed only from exposed surfaces. Relatively greater thermal conductivity of large grain UO_2 was demonstrated by lack of structure change in ½-inch diameter single, bi- and tricrystal pellets irradiated to generate approximately 760,000 Btu/(hr)(ft^2). Ceramographic examination of irradiated, cold-swaged UO_2 revealed sintering between point contact at bulk fuel temperature of only 300 to 400°C. Cold-swaged, Zircaloy-clad UO_2 PRTR fuel rods burst at pressures (7820 and 7880 psi, at 550 F) three times greater than those expected in PRTR rods after 10,000 Mwd/ton$_U$ exposure. Al-Pu alloy specimens containing 6.33, 16.33, and 27.17 percent Pu^{240} were irradiated for investigation of reactivity change. Comparative irradiation tests of uniformly and variably enriched PuO_2-UO_2 fuel rods revealed evidence of dissolution of impurity nitrogen by the Zircaloy cladding of the higher heat flux rods. Fuel performance was comparable in all rods. No redistribution of PuO_2 particles in MgO occurred during irradiation of immiscible mixtures of MgO-PuO_2 pellets, even in columnar grain growth regions. Unusual microstructures were developed during irradiation of ZrO_2-PuO_2 pellets. Approximately the same degree of in-reactor sintering was found in irradiated, swaged UO_2-PuO_2 PRTR fuel rods containing 80 or 160 UO_2 and PuO_2 increments. The equiaxed grain growth that occurred is typical of 0.565-inch diameter fuel rods irradiated to generate 300,000 to 400,000 Btu/(hr)(ft^2). Encouraging alleviation of fuel element process tube wear and fretting corrosion was achieved by additions of extended surface, clip-on fuel element wear pads. Postirradiation examination of a failed, swaged MgO-PuO_2 PRTR fuel element revealed regions of anomalously high PuO_2 content, one of which probably coincided with the point of failure. A ductile split propagated from the point of original brittle failure associated with an external layer of massive zirconium hydride and severe internal corrosion. Four PRTR fuel elements were removed from service because of mechanical damage found during postdecontamination inspection. PuO_2 content had a marked effect on structure changes during irradiation of low density UO_2-PuO_2 fuel, but little effect in high density pellets. High density pellets incorporating mixed crystal $(U,Pu)O_2$ developed more extensive grain growth and released more fission gas than did pellets made from mixtures of UO_2 and PuO_2. Fuel capsules performed adequately to 10,000 Mwd/ton UO_2–

PuO_2. Drillings taken along the diameter of an irradiated UO_2 fuel core confirmed earlier findings of gross fission fragment relocation during irradiations, but revealed no plutonium migration. Three test devices for in-reactor fuel evaluation are described. (auth)

23867 (LA-1349(Del.)) A METHOD OF CLEANING PLUTONIUM METAL SAMPLES FOR ANALYSIS. William G. Smiley (Los Alamos Scientific Lab., N. Mex.). Feb. 2, 1953. Contract AT(11-1)-Gen-8. 13p.

The usual method of removing surface oxide from Pu metal samples, by electrolytic cleaning in a mixture of ethylene glycol and phosphoric acid, is not satisfactory for preparing samples for O_2 determination. Samples prepared in this way give erratic O_2 values. A method of electrolytic cleaning, using a 20% aqueous potassium carbonate solution as the electrolyte, is described. The sample is placed in a rotating Ta cup which is made the anode. Electrolysis for two minutes at 4.5 volts is usually sufficient. Samples cleaned by this method give lower and more consistent O_2 results than those prepared the other way. This method is also neater and more convenient. (auth)

23868 (NLCO-862) THE INVERSION OF POLE FIGURES FOR MATERIALS HAVING ORTHORHOMBIC SYMMETRY. Peter R. Morris and John W. Colby (National Lead Co. of Ohio. Cincinnati). [Mar. 13, 1963]. Contract AT(30-1)-1156. 17p.

A method for inverting pole figures for materials having orthorhombic symmetry is described. The method entails expansion of the axis distribution function in a series of polynomials of appropriate symmetry, even in x_1, x_2, x_3. Truncation of the series at order n = 2, 4, 6, . . . requires the solution of $n/48\ (n^2 + 12n + 44) - 1$ simultaneous linear equations, obtained from m pole charts, where $m(n/2 + 1) \geq n/48(n^2 + 12n + 44) - 1$. (auth)

23869 (NP-12789) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Patricia B. Plate, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Apr. 1963. 56p.

Eighty-one references on high-strength alloys, light metals, non-metallics, refractory metals, and coatings are given to reports, books, and U. S. and foreign journals published from June 1962 through April 1963. Separate author, report number, and subject indexes are included. (P.C.H.)

23870 (TID-16871) SOME OBSERVATIONS ON THE USE OF ELLIPTICALLY POLARIZED LIGHT TO STUDY METAL SURFACES. Frederick P. Mertens and Robert C. Plumb (Worcester Polytechnic Inst., Mass.). [Sept. 1962]. Contract [AT(30-1)-2479]. 28p.

Measurements and calculations using ellipitically polarized light to determine the thickness and index of refraction of barium stearate films on a variety of substrates are described. Attention is focused primarily upon problems associated with the study of very thin films, that is, films which are less than 100Å thick. An apparent dependence of the index of refraction, n, and extinction coefficient, κ, and independence of the absorption coefficient, k, upon the angle of incidence was observed and is discussed. Several effects, including accuracy and sensitvity, of the angle of incidence in studying film growth are noted. It is shown that there exists a characteristic angle of incidence at which the growth of a film produces a negligible change in the ellipticity, and it is shown how advantage may be taken of this to study rapidly changing surfaces. It is demonstrated that extraneous films are satisfactorily accounted for in measuring thin films by means of the Drude equations through their effects upon the apparent optical constants of the substrate. Advantage may be taken of this fact to improve the linearity of the Drude linear approximation. The problem of the anomalous index of refraction of very thin films as determined by the Drude equations is considered. It is concluded that the anomalies revealed by the Drude equations are associated with the system under study and are not caused by any inherent limitation in the Drude equations. It appears that at the interface between a dielectric layer and metal system there is an absorbing region which produces the anomaly in the refractive index calculated by the Drude equations and which must be allowed for in any method of calculation. (auth)

23871 (TID-16897) A NOISE-REDUCING ENCLOSURE FOR A FOUR-DIE SWAGER. B. H. Butler (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Oct. 1962]. Contract AT(07-2)-1. 10p.

A noise-reducing enclosure was designed and constructed to reduce the noise level of a four-die swager from an overall frequency band level of 119 to 90 decibels. Noise levels in component octave bands were reduced to 87 db or lower. The enclosure also contained radioactive dusts produced by the swaging of uranium. (auth)

23872 (TID-18626) PHYSICAL METALLURGY OF UNCOMMON METALS. Final Report. Robert E. Ogilvie and John T. Norton (Massachusetts Inst. of Tech., Cambridge). Mar. 1, 1963. Contract AT(30-1)-981. 15p.

The physical metallurgy, magnetic research, and crystal chemistry of metals are discussed. Experiments were made on: solubility limits and diffusion of Fe and Ni in Be primary solid solutions; texture and elastic anisotropy of Nb and Mo; modes of deformation in alpha uranium; diffusion in the U–Nb system; x-ray detection of cladding defects; precision x-ray stress analysis of U and Zr; texture of cold-rolled Ta; radiation damage in Ni crystals; magnetic properties of UH_3, UMn_xFe_y, Fe_2O_3, and CoO; structural relations in the pseudo-binary system $ZrFe_2$–$ZrCr_2$, and crystal structures of silicides. (P.C.H.)

23873 (UNC-5048) THE DEVELOPMENT OF URANIUM CARBIDE AS A NUCLEAR FUEL. Third Annual Report, September 1, 1961 to October 31, 1962. J. Crane, H. S. Kalish, and F. B. Litton (United Nuclear Corp. Development Div., White Plains, N. Y.). Jan. 15, 1963. Contract AT(30-1)-2374. 51p.

The effects of carbon content and fabrication method on irradiation stability, thermal conductivity, and hot hardness of uranium carbide were determined. Hypostoichiometric and stoichiometric uranium carbides prepared by both powder metallurgy and skull casting and hyperstoichiometric cast carbide were tested. The preparation of 12% enriched uranium carbide specimens for irradiation testing was completed. Sintered specimens were 98% of theoretical density for hypostoichiometric uranium carbide and 92 to 93% of theoretical for stoichiometric uranium carbide. All cast specimens were above 98.7% of theoretical density. Five different specimens, 4.4 and 4.8 ± 0.1 wt % carbon, cast material and sintered material, and 5.2 ± 0.1 wt % carbon, cast uranium carbide, were canned separately in niobium-1 wt % Zr and inserted into each of three capsules. The fuel specimens in capsule UNC-1-2 were contained in a sodium bond. This capsule was removed after 15,000 MW-d/ton U burnup in the MTR. The specimens in capsule UNC-1-3 were canned using an interference fit between cladding and fuel. This capsule was removed from the MTR after 14,440 MW-d/ton U burnup. Fuel surface temperatures ran in the range of 650 to 870°C and center-line temperatures were calculated

at about 1050 to 1100°C. Specimens were prepared for thermal expansion, thermal conductivity, and hot hardness measurements. These properties are being determined from room temperature to 1000°C for multiple specimens of each test condition. Thermal expansion of uranium carbide from room temperature to 1000°C was found to be 12.4×10^{-6} per °C for 4.4 wt % carbon sintered material, and 11.5×10^{-6} per °C for 4.7 wt % carbon cast material. Additional data on thermal expansion are currently being obtained. Out-of-pile compatibility tests were run at 815°C for 260 hr for hypo and hyperstoichiometric uranium carbide with niobium-1 wt % Zr cladding and with sodium as the bonding material. The hypostoichiometric material was prepared by powder metallurgy; the hyperstoichiometric carbide was made by skull casting. These tests showed some surface damage of the uranium carbide at both levels of carbon content. This damage was in the form of oxidation of free uranium in the case of the low carbon material and appeared as small cracks and chipping in the case of hyperstoichiometric material. Evidence of carburization to a depth of 0.0001 in. was noticed at the surface of the cladding used with the hyperstoichiometric uranium carbide. The evidence was not conclusive and no decarburization of the fuel was observed. Exposure tests of cast uranium carbide specimens with as-cast as well as ground surfaces and at three levels of carbon content, 4.5, 4.7, and 5.3 wt % were performed. Satisfactory resistance to corrosion was observed for 4.5 and 4.7 wt % carbon material exposed to laboratory air for about 10 months, but the 5.3 wt % carbon specimens, both as-cast and ground surfaces, showed transverse cracking after five months. All specimens stored in vacuo showed some surface attack and slight pitting starting after five months storage but no cracking was observed. Carbon content of these specimens did not appear to have any effect on corrosion behavior. Additional information was gained on the reproducibility of the skull casting method during preparation of castings for property studies. This information indicated that stoichiometric UC castings containing less than 200 ppm oxygen and 100 ppm nitrogen could be consistently made to 4.8 ± 0.1 wt % carbon using 4.6 wt % carbon feed material obtained by solid state reaction of UO_2 with graphite. A homogeneous skull of 4.8 wt % carbon was required. Similar reproducibility of casting carbon content was achieved at other carbon levels. Methods for minimizing certain casting defects were also found. The density of sintered uranium carbide was found to be strongly dependent upon carbon content. Carbon powder (4.3 to 4.4 wt %) was sintered to 96 to 98% of theoretical density, with little or no change in carbon content, while 4.5 wt % carbon powder was sintered to stoichiometric UC at 90 to 93% of theoretical density. The change in carbon content of the latter appeared to be due to uranium volatilization at the 1800°C sintering temperature; sintering of the low carbon material was performed at 1200°C. (auth)

23874 (UCRL-10433) PURE DIFFUSIONAL MASS TRANSFER IN ZONE MELTING. W. R. Wilcox and C. R. Wilke (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). Aug. 1962. Contract W-7405-eng-48. 31p.

The differential equation and boundary conditions for pure diffusional mass transfer in zone melting were derived. Numerical solutions were obtained and approximated algebraically for eutectic-forming systems. An analytical solution for constant distribution coefficient was obtained. Graphs are given which permit rapid approximation of concentration profiles resulting from one zone pass. Example problems are provided which illustrate the use of the calculation techniques developed. (auth)

23875 (USBM-U-929) ELECTRON-BEAM PURIFICATION OF HAFNIUM. W. E. Anable and R. A. Beall (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Nov. 1962. 54p.

The purification of Hf by electron-beam melting at moderate energy inputs and at low pressures was examined in detail. Most metallic impurities and H were removed in the first few minutes of operation; O, C, and N were removed at a slower rate. A comparison of evaporation rates derived from test data with rates calculated from vapor pressure data revealed that some of the Zr and Hf evaporated as monoxides; it appears that the remaining impurities were evaporated in metallic form. Samples treated by electron bombardment suffered a small loss of weight, and a gradual lowering of hardness. The magnitude of each change varied with the energy input and the duration of the melt. (auth)

23876 (USBM-U-1031) QUARTERLY METALLURGICAL PROGRESS REPORT NO. 18, FOR THE PERIOD JANUARY 1 TO MARCH 31, 1963. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Contract AT(11-1)-599. 34p.

The phase relationships of dysprosium, erbium, gadolinium, and samarium-rich alloys of selected non-rare earth metals were summarized in the form of diagrams. Hot water testing of dysprosium, gadolinium, and their alloys indicated that aluminum additions increased the corrosion resistance of the rare earth metal. Investigation of samarium-rich alloys of magnesium indicated the presence of the compound SmMg and a eutectic or eutectoid. A tentative hafnium-iridium phase diagram which has four compounds, two eutectics, and one eutectoid was drawn. The composition limits of the carbide, HfC, in the hafnium-carbon system occur at 3.9 and 5.9 wt % carbon by using composition-parameter graphs. Metallographic data indicate that the limits were 4.0 and 6.7 wt % carbon, respectively. Melting temperature and hardness of thorium were lowered by additions of either cerium or lanthanum. An increase in oxidation rate at 600°C was observed for thorium with additions of holmium. Pressed and sintered powder compacts of alloys of molybdenum or tungsten with gadolinium oxide were fabricated to plate and sheet in an attempt to produce specimens for determining the physical, mechanical, and chemical properties of such alloys. The tungsten-rare earth oxide mixtures containing 10, 20, and 30% each of samarium, erbium, or europium oxides were sintered in hydrogen at 1,500°C for 8 hours. Diffusion reactions at 1,100°C between pieces of niobium metal were inhibited when samarium was used as the plating metal; no visible effect on the reaction was noted when zinc, cobalt, molybdenum, or titanium was the plating metal; and an increased diffusion rate was noted when copper or silver was used as the plating metal. Welds in sheets of niobium 0.1 inch thick were brittle when the oxygen content was 640 ppm or greater with nitrogen at 220 ppm and carbon at 60 ppm. A segmented crucible is being fabricated that will allow more careful heat transfer measurements to be made. Attempts to remove residual oxygen from yttrium by adding small amounts of other elements which may getter the oxygen and then be removed by evaporation were not particularly successful. Manganese evaporated from titanium rather easily. Small amounts of carbon reduced the oxygen content of zirconium. Hafnium carbide castings poured in rotating molds had better surface detail,

finer grain structure, and greater density than similar castings from static molds. (auth)

23877 (VDIT-73) ALUMINUM–TITANIUM ALLOYS. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Apr. 1963. 30p.

References (68) on the phase structure, mechanical properties, fabrication, effects of impurities on properties, corrosion, thermal conductivity, and radiation effects on Al–Ti alloys are given to reports and U. S. and foreign journals published from December 1951 through August 1961. (P.C.H.)

23878 (VDIT-74) ALUMINIUM–ZIRCONIUM ALLOYS. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Apr. 1963. 21p.

References (50) on structure, mechanical properties, corrosion, radiation effects, and fabrication of Al–Zr alloys are given to reports and U. S. and foreign journals published from 1950 to 1962. (P.C.H.)

23879 (EURAEC-402) DEVELOPMENT OF PROCESSES FOR THE PREPARATION OF URANIUM CARBIDES AND OF CERMETS ON A UC BASE. Final Report No. 2, April 1, 1961 to June 30, 1962. P. Himmelstein, F. Hofmann, B. Liebmann, O. Neumann, and L. Schaefer (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 061-61-5-RDD. 49p. A translation.

Work during the period on preparation of UC by the solid-state reaction UO_{2+x} + (3 + x) C → UC + (2 + x) CO is reported. Various types of UO_2 and C were checked as to their suitability as starting materials. UO_2 prepared from ADU by calcination and reduction at 800°C and graphite proved to be the most suitable materials. The most favorable conditions for carrying out the solid state reaction were found. The influence of the surface of the UO_2 and of the temperature on the reaction rate was determined. UC with a density of 8 to 9 g/cm^3, a total C content of 4.8 ± 0.2 wt %, an O_2 content of 0.1 wt % and a free C content of 0.05 wt % was produced. Two arc furnaces for melting of UC were built along with a special device for cutting the cast UC rods. Density, hardness, impact strength, and grain sizes of several rods were measured. Swaging experiments were carried out with fused UC. Densities of 01.5% of the theoretical were obtained. (auth)

23880 (EURAEC-534) DEVELOPMENT OF PROCESSES FOR THE PREPARATION OF URANIUM CARBIDES AND OF CERMETS OF UC-BASE. Quarterly Report No. 10, October 1 to December 31, 1962. P. Himmelstein, F. Hofmann, B. Liebmann, and L. Schaefer (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang Hanau am Main, Germany). Work Performed under United States–Euratom Joint Research and Development Program. Contract 088-62-7-RDD. 12p. A translation.

The UC reaction furnace for semicontinuous operation was prepared and used in a full day's test run. It was found that 19 kg of UC could be prepared at a stretch at a throughput of about 3 kg of UC per hour. For investigating further the casting of rods of more than 20 mm in diameter by means of the centrifugal casting process, the existing furnace was redesigned in order to provide a continuous adjustment of its centrifugal speed. In this way it will be possible to investigate the effects of various casting velocities on the yield and on the quality of the rods. Further tests were made with a tipping furnace to determine whether this type is also suitable for casting rods. The study of the properties of the 114 cast reactor test rods was concluded. A determination was made of the total C, the free C, the O_2, and the N_2 contents. Hardness and density were measured. About 81% of the test rods had a C content of 4.75 ± 0.1%, 94% of the rods satisfied the specification of 4.75 ± 0.15%. (auth)

23881 (NP-tr-1011) DETERMINATION OF THE PURITY OF METALS BY MEANS OF DAMPING MEASUREMENTS. H. J. Seemann and R. Mandler. Translated by L. Herdan (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Vakuum-Tech., 11: 161-7(1962). 35p.

By consideration of selected examples, the possibilities of using damping measurements to determine the purity of metals are shown. The method makes possible the specific determination of certain impurities, especially of gases such as nitrogen and oxygen. This represents an advantage over measurements of residual resistance since these refer mostly to the total amount of impurities (including lattice defects). (auth)

23882 PRODUCTION OF BERYLLIUM OXIDE. J. D. Hayton (Australian Mineral Development Labs., Adelaide, South Australia). At. Energy, 6: No. 2, 21-5(Apr. 1963).

Some of the processes which are used or are proposed for the production of BeO are discussed. The main source of BeO is the mineral beryl which occurs in many parts of the world. Brief descriptions are given of the occurrence, distribution, and processing of beryl. Health hazards in handling Be or its compounds are reviewed. (C.H.)

23883 THE THERMAL EXPANSION OF NIOBIUM PENTOXIDE AND ITS EFFECT ON THE SPALLING OF NIOBIUM OXIDATION FILMS. D. L. Douglass (General Electric Co., Pleasanton, Calif.). J. Less-Common Metals, 5: 151-7(Apr. 1963). (In English)

The thermal expansion coefficients of stoichiometric and nonstoichiometric niobium pentoxide were determined from 20 to 1000°C and 20 to 500°C, respectively, and were found to be significantly smaller than that of niobium metal. The thermal stresses were calculated which are induced during cooling of a coherent oxide-coated niobium plate. In the absence of volume mismatch of oxide and metal it was concluded that thermal stresses due to differences in expansion coefficients should not cause spalling when the oxidized sample is cooled from 600°C. A more realistic appraisal, which is consistent with experimentally observed spalling, was made by consideration of the very large strains arising from coherency of the voluminous oxide on the more dense metal. The surface layers of the substrate may deform plastically during oxidation at high temperatures, even though appreciable contamination and strengthening has occurred. Upon cooling, however, the added thermal stresses and decreasing plasticity of the contaminated substrate may lead to spalling, the crack initiating in the contaminated metal and propagating into the brittle oxide. (auth)

23884 THE APPLICATIONS OF RADIOACTIVE TRACERS IN PHYSICAL METALLURGY. P. Lacombe (Ecole des Mines, Paris). Schweiz. Arch. Angew. Wiss. Tech., 28: 269-84(July 1962). (In French)

The uses of radioactive tracers in metallurgy are discussed. A method that may be used in attacking a diversity of problems is described. A review of the physical methods in iron metallurgy is presented. The metallography of copper, aluminum, or metals for reactor construction uses with success the same experimental methods. The uses of tracers in the adjoining fields of metallurgy were

also proved to be fruitful. Tracers are used in solving corrosion and grinding problems, in the preparation and concentration processes for ores and minerals, and for increasing the accuracy of the determination of trace elements in metals. (tr-auth)

23885 SOME APPLICATIONS OF VACUUM TECHNIQUES IN THE METALLURGY OF NON-FERROUS METALS. B. Tougarinoff (Recherches de la Société Générale Métallurgique, Hoboken, Belg.). Schweiz. Arch. Angew. Wiss. Tech., 28: 491-8(Dec. 1962). (In French)

A brief survey of the requirements of vacuum techniques for use in metallography is given (the pumps, furnaces, and chemical reactions). Practical examples were chosen for the preparation of the metals Zn, Cu, Cd, Ta, Nb, Ge, Si, and U. (tr-auth)

23886 PRACTICAL POSSIBILITIES FOR VACUUM OUTGASSING AF ALUMINUM. F. Rohner (Forschungsinstitut der AIAG, Neuhausen am Rheinfall, Switzerland). Schweiz. Arch. Angew. Wiss. Tech., 28: 499-501(Dec. 1962). (In German)

Among the gases absorbed from the atmosphere by aluminum, hydrogen is uniquely significant. Its solubility and diffusion possibilities in melted and in solidified aluminum are discussed. The effects of hydrogen on aluminum and the possibility of removing it by vacuum treatment are considered. (tr-auth)

23887 METALLURGY IN NUCLEAR POWER TECHNOLOGY. J. C. Wright. Englewood Cliffs, N. J., Prentice-Hall Inc., 1962. 188p. $8.95.

A broad survey is presented of the metallurgical principles of the special materials used in nuclear power technology. The production, fabrication, and properties of U, Pu, and Th and their behavior under irradiation are described. The production of Zr, Be, and Nb are also discussed. Fuel canning materials, fuel element technology, and radiation effects on nonfissile materials are considered. Finally, coolant and containment problems in reactors are treated. (D.L.C.)

23888 METHOD FOR PRODUCING HIGH-PURITY GRAPHITE. Erich Nedopil (to Siemens-Planiawerke AG fur Kohlefabrikate). U. S. Patent 3,089,754. May 14, 1963. Priority date Oct. 25, 1957, Germany.

The method comprises treating a graphite portion with a gaseous halogen or halogenide in order to remove impurities, and then scavenging the graphite. The scavenging is carried out in two steps, first with nitrogen at a temperature at which all halogenides and halogens are removed (~2700°C), and then with carbon monoxide at the same temperature. (D.L.C.)

Corrosion

23889 (ARF-B198-39) IMPROVED ZIRCONIUM ALLOYS. Quarterly Report, January 1, 1963–March 31, 1963. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 10, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-578. 17p. (EURAEC-653)

On the basis of 4800 hr exposure to 680°F water, a number of ternary compositions were shown to have corrosion resistance superior to Zircaloy-2. In addition, the strength and hydrogen pickup properties of the alloys were generally improved over Zircaloy-2. The promising alloys were based on the binary materials Zr–1Sb, Zr–1Cr, Zr–0.5Nb, and Zr–0.5Sn to which small percentages of Te, Ge, Cr, or Fe were added. At present, 680°F water corrosion data for an exposure time of 5000 hr are available for the modified ternary alloys. Development of materials for potential service in 750 and 900°F steam proceeded in a manner similar to that for 680°F water application. On the basis of corrosion resistance and strength, the alloys Zr–3Cr–1Fe, Zr–3Cr–0.25Te, and Zr–1V–1Fe were considered highly promising and initially acceptable. However, hydrogen pickup properties, which were about the same as Zircaloy-2, were judged as unacceptable. In an attempt to improve this characteristic as well as to further enhance corrosion resistance and strength, an additional series of ternary alloys was prepared. The compositions studied in 900°F steam did not exhibit satisfactory corrosion resistance. (P.C.H.)

23890 (BMI-X-10040) DEVELOPMENT OF NIOBIUM-BASE ALLOYS FOR USE IN A NUCLEAR SUPERHEATER. Quarterly Progress Report, January–March 1963. John A. DeMastry, Arthur A. Bauer, and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 12p. (EURAEC-626).

Fabrication and corrosion behavior of niobium alloys resistant to 1000 to 1300°F steam for structural or cladding applications in a nuclear superheater is reported. The results indicate that a number of the niobium alloys are suitable for superheater application. (N.W.R.)

23891 (NAA-SR-7755) CORROSION OF STRUCTURAL MATERIALS IN IMPURE SANTOWAX. R. S. Neymark (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 15, 1963. Contract AT(11-1)-Gen-8. 36p.

Corrosion rates were measured for a variety of structural materials exposed to commercially available terphenyls (Santowax) at elevated temperatures in agitator-autoclaves and in a pumped loop. Corrosion rates were determined as a function of water content, cover gas, fluid velocity, and temperature. A number of metals were found to be compatible with impure Santowax. Those of special interest for use in organic-cooled reactors included carbon and low-alloy steels, stainless steels, Al, and the Al-base cermets (APM alloys). Other corrosion-resistant metals included Be and Nb. Al was attacked when the water content exceeded 1000 ppm. Metals unattractive for use in contact with organic coolant included Mg and its alloys, Zr and its alloys, Zn, Cu, and brass. OMRE operating experience showed that the corrosion of structural steel is of concern, not in terms of decreasing metal wall thickness, but rather in terms of contamination of the coolant. Particulates of steel corrosion products had to be in the coolant for it to form fouling films. The rate of particulate formation in the OMRE seemed directly dependent on the water or air contamination of the coolant, in sharp contrast to the laboratory experiments where the corrosion of carbon steel was insensitive to Santowax water contents up to 2000 ppm. (auth)

23892 (TID-16858) THEORY OF OXIDATION OF METALS. Joseph Boggio (Worcester Polytechnic Inst., Mass.). Sept. 1962. Contract [AT(30-1)-2479]. 54p.

The theory of the oxidation of metals is reviewed, and an improved theory is presented which takes into account the space charge caused by the contact potential associated with electronic equilibrium between a metal and its growing oxide film. The theory is compared with experiment. (auth)

23893 OBSERVATION OF OXIDATION OF INTENTIONALLY PUNCTURED DUMMY FUEL ELEMENT. STUDY ON THE BEHAVIOR OF PUNCTURED FUEL ELEMENT FOR CALDER-HALL TYPE REACTOR. [PART] I. Kiyoaki Taketani and Katsuichi Ikawa (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 310-15(Apr. 1963). (In Japanese)

As the first step of a series of experiments designed for the hazards evaluation of the uranium fuel for the Calder-Hall type reactor of Japan Atomic Power Co., its oxidation by air at 550°C was investigated. The specimen used is a dummy fuel element, Magnox-clad uranium rod, with a pinhole on the cladding. The pinhole diameter ranges from 0.3 to 1.2 mm, and the thickness of the cladding is 1.6 mm. Because a small gap between the rod and the cladding was developed by heating, the oxidation of uranium proceeded over a considerable area in spite of the small diameter of the pinhole. Remarkable swelling around the pinhole was observed at about 300 mg of weight gain by oxidation and burst of the cladding occurred when the weight gain reached about 1000 mg. The subjects of this series of experiments are (1) oxidation behavior, (2) oxidation rates of the intentionally punctured dummy fuel element, (3) diffusion coefficient of fission gas in the oxide powder, (4) correlation of oxidation with fission gas release, and (5) oxidation by decomposed carbon dioxide. (auth)

23894 CORROSION RESISTANCE OF CHROMIUM STEEL IN WATER AND STEAM AT CRITICAL PARAMETERS. V. V. Gerasimov, A. I. Gromova, and A. A. Sabinin. Teploenerg., No. 3, 22-5(Mar. 1963). (In Russian)

Effects of water composition (oxygen, chloride, and sulfate) pH, and welding on the corrosion and electrochemical behavior of stainless steel alloyed with 3 to 25% Cr and up to 2% Mo and Ni were investigated. (R.V.J.)

Fabrication

23895 (AD-403514) COLUMBIUM ALLOY EXTRUSION PROGRAM. PHASE V. TUBING PROGRAM. Interim Report VIII, January 15, 1963–April 15, 1963. E. V. Peterson (Du Pont de Nemours (E. I.) & Co. Metals Center, Baltimore). Contract AF33(600)-40700. 37p.

The final tube blank extrusion campaign is described, and the tube-reducing program for extruded tube blanks of B-66 (Nb–5Mo–5V–1Zr) and D-43, previously designated X-110, (Nb–10W–1Zr–0.1C) is discussed. Some of the X-110 blanks were processed through four reductions with 2600°F anneals after the first and third reduction. The outside surfaces were good. The inside surfaces were improved by in-process conditioning, but a few defects still remained. Attempts to make reductions on the B-66 blanks resulted in cracking. (P.C.H.)

23896 (AAEC/E-104) THE PREPARATION OF SPHEROIDAL UO_2–ThO_2 PARTICLES. K. D. Reeve and K. A. Jones (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1963. 11p.

A self-abradory process is described for the small-scale preparation of 150- to 200-μ spheroidal particles of various UO_2–ThO_2 compositions. The particles can be sintered to high densities before or after dispersion in beryllium oxide. Because of the high compaction pressure used in making particles, they are strong enough to resist abrasion and crushing during mixing with beryllium oxide powder. After sintering, the particles consist of a $(U,Th)O_2$ solid solution with a small range of composition, but the overall composition does not vary from one particle to another. The types of porosity observed after sintering are consistent with the occurrence of two competitive mechanisms during spheroidization, namely, abrasion and particle build-up. (auth)

23897 (CEND-178) THE DEVELOPMENT AND TESTING OF UO_2 FUEL SYSTEMS FOR WATER REACTOR APPLICATIONS. Quarterly Progress Report for Period Ending March 31, 1963. B. E. Murtha and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Apr. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2863. 71p. (EURAEC-690)

Densities in the range of 88 to 89% of theoretical were established as the maximum practical value attainable by economical vibratory compaction methods utilizing total densification and compaction times of 5 to 6 minutes and economical particle size distributions in which 100% fuel utilization is attained. On this basis, all work on pneumatic compaction of simple rod geometries was terminated. Work was initiated on the development of fuel elements of complex geometries. Densities in the range of 84 to 87% of theoretical were attained for individual rods compacted simultaneously in a thirty-seven rod array by means of a high impact pneumatic vibrator. The initial trend for a decrease in average density with an increase in the number of rods compacted simultaneously disappeared in the region between 19 and 37 rods. Achievement of densities of 87% of theoretical in some rods in the 37 rod array offers the possibility that this density may be achieved on all rods when proper alterations in compaction conditions are made. Pressure drop and vibration tests on the projection welded cluster indicated that flow induced vibrations are negligible and that the "drag coefficient" method for pressure drop calculations is more applicable than the orifice method for this cluster. Construction of the thermal cycling test apparatus was completed. Construction was completed of the equipment to study the thermal performance of fuel elements and to establish microstructure temperature relationships. Experimental results verified early heat transfer calculations for the system. Testing of UO_2 fuel elements was initiated. (auth)

23898 (CEND-179) BURNABLE POISON ADDITIONS TO UO_2. Quarterly Progress Report for Period Ending March 31, 1963. G. Zuromsky, R. C. Brayer, W. C. Taylor, and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Apr. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3107. 31p. (EURAEC-692)

A series of fuel rods was compacted by the electromechanical and pneumatic methods with the object of determining boron homogeneity. An attempt was made to correlate the results of chemical analyses for boron with gamma scan measurements of local density variations and sieve analyses of local rod sections for the distribution of fines. Each fuel rod was loaded incrementally with charges of UO_2 containing 0.05 wt % B_4C as minus 325 mesh powder. These powder mixtures were compacted to densities up to 88% of theoretical. Analyses of local density variations were made at a number of intermediate density levels by means of gamma scanning. Local segregation of UO_2 and B_4C occurred during the early stages of powder densification and was shown to be related to the local variations in the concentration of fines for the electromechanical process. The two compaction methods produced similar amounts of minus 200 mesh fines with approximately

equivalent increases in the minus 325 mesh fraction at the expense of the 200/325 fraction. A method for boron analysis, based on the difference in solubility of UO_2 and B_4C in nitric acid, was evaluated and compared to the carbonate fusion quinalizarin technique. This approach requires the expenditure of only 20% of the time needed for the standard carbonate fusion quinalizarin technique. Adequate accuracy for large size samples was achieved. A series of fuel rods for the thermal gradient studies was compacted to 86.5% of theoretical density by the electromechanical method. These rods contain an axially positioned tungsten heater, 0.075 inch in diameter, within the 8-inch long fuel column. Destructive evaluations of these rods are in progress to determine boron distribution by chemical methods as well as variations in local density and local distribution of UO_2 and B_4C fines. Methods of introducing axial thermal gradients by means of an external heater or by means of a variable thickness ceramic sleeve along the cladding are under investigation. (auth)

23899 (HW-74304) CALCULATED COSTS OF FABRICATION OF PLUTONIUM-ENRICHED FUEL ELEMENTS. H. E. Hanthorn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1962. Contract AT(45-1)-1350. 131p.

Comparative fabrication costs of Zircaloy-clad, rod-bundle fuel elements, using UO_2 enriched with U^{235} or with low Pu^{240}-content Pu as the fuel material, were estimated at a plant capacity of 1 ton of U per day, 20 tons per month. Depending upon assumed fuel life in the reactor, such a plant would supply about 10 power reactors the size of Dresden with fuel. The fuel elements used by the 10 reactors would have to be composed of rods within reasonable ranges of diameter and length, so that the same machinery could be used for fabrication; considerable freedom in number and arrangement of rods in the final assemblies could be accommodated, however. Study results indicate that the total fuel element cost difference between U-enriched and Pu-enriched fuels is not great. This is because several large elements of cost are common to the two materials. (auth)

23900 (KR-38) A CHAMBER FOR WELDING OF REACTIVE METALS UNDER CONTROLLED ATMOSPHERE. Ragnar Hagemann Soevik (Norway. Institutt for Atomenergi, Kjeller). Jan. 1963. 19p.

An experimental facility for protecting reactive metals during welding is described. Comments are made on operational experience and recommendations are given for improvements. (auth)

23901 (LADC-5719) MULTIPLE CASTING OF FUEL PINS FOR THE LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENTS. J. W. Anderson and W. J. Maraman (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 24p.

The small critical mass of Pu which limits charge size, coupled with its value necessitating quantitative recovery from all residues, makes the precision casting of Pu-bearing alloys in reusable permanent molds doubly important. The use of thin CaF_2 coatings on molds, vacuum casting techniques, and dimensional stabilizing treatments makes it possible to cast parts with shapes very close to the desired finished dimensions. Alloying and casting procedures for manufacturing two types of fuels for the LAMPRE (Los Alamos Molten Plutonium Reactor Experiment) program are described. (auth)

23902 (NAA-SR-6246) CARBURIZATION OF AUSTENITIC STAINLESS STEEL BY URANIUM CARBIDES IN SODIUM SYSTEMS. B. A. Webb (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 31, 1963. Contract AT(11-1)-Gen-8. 33p.

The stability of uranium carbides in sodium-bonded stainless steel cladding was studied in long-term compatibility tests at 1000, 1200, and 1600°F, out of pile. No apparent carburization of the cladding occurs when the C content of the UC is 4.8 wt % or below. Extensive carburization of Type 304 and Type 347 stainless steels occurs at 1000°F and above, when the C content of the UC exceeds 4.8 wt %. The degree of cladding carburization increases with the C content of the UC composition. From the results, it was calculated that stainless steel cladding (0.010 in. wall thickness) with sodium-bonded, 0.500-in. dia. U–4.9 wt % C fuel could be carburized to an average C content of 0.5 to ~2.0 wt % in three years of reactor operation at a 1000°F fuel surface temperature. At a 1200°F surface temperature, the C level in the cladding could range from ~1.2 to ~2.0 wt %. As the fuel diameter increases, the upper carburization limit increases, since the ratio of fuel volume to cladding volume increases. Therefore, 0.800-in. dia. U–4.9 wt % C fuel could carburize the cladding to a maximum 3% level. Results of 300-hr, 1600°F tests, using transformed and as-cast specimens, indicate C transfer from transformed fuel to the cladding at 1600°F proceeds at a very slow rate, compared to as-cast fuel. (P.C.H.)

23903 (NMI-2803) PROGRESS ON THE STUDY OF BETA TREATMENT OF URANIUM, DECEMBER 1, 1960–MARCH 30, 1961. R. B. Russell (Nuclear Metals, Inc., Concord, Mass.). Apr. 21, 1961. Contract AT(30-1)-1565. 74p.

The variables affecting the beta treatment of uranium are described. Results are included on the effects of time at beta temperature, the influence of air delay before quenching, and the effects of 600°C annealing. A description of x-ray automation equipment is presented. (N.W.R.)

23904 (NMI-2804) PROGRESS ON THE STUDY OF BETA TREATMENT OF URANIUM, APRIL 1, 1961 TO JULY 31, 1961. R. B. Russell and A. K. Wolff (Nuclear Metals, Inc., Concord, Mass.). Sept. 1, 1961. Contract AT(30-1)-1565. 108p.

Progress on the work on the effect of variables affecting the beta treatment of uranium is described. Included are results on the effect of beta time and temperature on the as-quenched grain size, the influence of air delay before quenching, and the growth index of metal isothermally transformed at different temperatures. The relative effects of both size and cooling medium on the radial growth index are summarized. (auth)

23905 (NMI-9700.9) DEVELOPMENT OF DIES FOR EXTRUSION OF COMPLEX SHAPES OF STEEL AND REFRACTORY ALLOYS. Interim Progress Report, January 1–March 31, 1963. J. G. Hunt, J. L. Klein, A. M. White, and R. G. Jenkins (Nuclear Metals, Inc., West Concord, Mass.). May 1963. Contract AF 33(657)-8798. 20p. (ASD-TDR-7-946(III))

Investigations were made on methods of fabricating and evaluating dies suitable for the high-temperature extrusion of steel and refractory metals of complex shapes. Successful methods of producing tungsten fibers for reinforced dies were developed. A die support system based on the concept of hydrostatic support for the die casing was developed and shown to be successful in preventing the cracking of brittle die nibs during extrusion. Studies were also made on fabrication of intermetallic dies by

both hot pressing and melting and forging; obtaining intermetallic dies from outside sources; finish grinding of round intermetallic dies; establishment of feasibility of hot pressing Tee dies; developing methods of making tungsten reinforcing fibers by rolling and swaging; development of a method for supporting dies so that the pressure from the extrusion billet results in a compressive force on the die nib to prevent cracking; establishing the value of refractory metals as promising substrates for coated dies; modification of a high temperature furnace to provide a 2 to 3 second loading time for TZM billets. It has been established that the indenter test in its present state of development is not a satisfactory means of screening die materials. (P.C.H.)

23906 (RADC-TDR-63-43) CERAMIC-METAL SEALS FOR HIGH-POWER TUBES. Final Technical Report, April 10, 1961 through October 31, 1962. Sperry Report No. NA-8250-8331. C. Johnson, I. Waraska, S. Cole, K. Styhr, and E. Cheatham (Sperry Gyroscope Co. Electronic Tube Div., Great Neck, N. Y.). Jan. 1963. Contract AF30(602)-2371. 93p.

Variables associated with the fabrication of metal-to-ceramic seals were investigated to understand the mechanisms of failures and to improve manufacturing processes. The program primarily involved an extensive reliability study in which ceramic bodies, metallizing mixtures, plating, sintering, brazing, and other sealing practices were statistically evaluated. Environmental, life, and leak path studies supported the primary investigations. Recommended manufacturing procedures and controls were incorporated into a manual on metal-to-ceramic sealing techniques. The results of the experiments were masked to a large extent by a residual error caused by uncontrolled and/or unknown variables. The ASTM test vehicle employed in the program was apparently the source of the variables. An operating nonpumping ion gage was constructed. Further refinement of the device is suggested. (auth)

23907 (TID-7620(Pt.I)) MINUTES OF THE ANNUAL ATOMIC ENERGY COMMISSION WELDING CONFERENCE HELD IN SAN ANTONIO, TEXAS, OCTOBER 3-6, 1960. (Southwest Research Inst., San Antonio). 272p.

Twenty-two papers on welding apparatus and procedures developed for specific uses (pressure-vessels, fuel elements, etc); research in welding; welding of specific metals; stress-relieving (and advisability of) of aluminum; stainless steels, and steels; and materials studies are presented. Separate abstracts were prepared for nineteen papers; the other three were previously abstracted in NSA. (D.C.W.)

23908 (TID-7620(Pt.I)(p.24-34)) FABRICATION OF FUEL ASSEMBLIES FOR EXPERIMENTAL GAS-COOLED REACTOR. E. A. Wick and R. L. Heestand (Oak Ridge National Lab., Tenn.).

The design and fabrication of fuel assemblies for the Oak Ridge Experimental Gas-Cooled Reactor are described. The assemblies consist of seven fuel elements formed by UO_2 pellets encased in stainless-steel tubes and positioned and supported within a graphite sleeve by a center spacer and top and bottom spiders. Six assemblies fill one reactor fuel channel. The fabrication sequence and techniques are covered in detail. (D.C.W.)

23909 (TID-7620(Pt.I)(p.35-40)) AUTOMATIC WELDING OF HANFORD ALUMINUM-CLAD FUEL ELEMENTS. George R. Hanson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The fully automatic welders used in the fabrication of Hanford aluminum-clad uranium fuel elements are briefly described. Conditions used are a welding speed of 12.5 rpm, a single-pass weld, a 40-60 mixture of Ar-He for the shielding gas, and an a-c welding current of 150 to 180 amp. Results of a comparison showing that direct current is better than alternating current for automatic welding are summarized. (D.C.W.)

23910 (TID-7620(Pt.I)(p.52-62)) A TEST PROGRAM TO DETERMINE MECHANICAL PROPERTIES IN WROUGHT DEPLETED URANIUM. Keith E. Mead (Sandia Corp., Albuquerque, N. Mex.).

Procedures followed in a test program to establish allowable design values for tensile properties in wrought depleted uranium and in welds joining this material are described. In addition to tensile tests, impact and fillet-weld shear tests were performed. Data are included. (D.C.W.)

23911 (TID-7620(Pt.I)(p.70-92)) ARC WELDING OF INCONEL FOR NUCLEAR POWER PLANTS. Jay Bland (Knolls Atomic Power Lab., Schenectady, N. Y.).

Since Inconel was chosen as a material for some nuclear power plant components, a weld program was undertaken to determine if welds of required quality could be produced in this material. Structural welding and weld overlays were considered, and welds joining Inconel with other materials and with Inconel were made. A variety of filler metals and welding techniques were also used. Results are presented and discussed, and some components already fabricated from Inconel are described. (D.C.W.)

23912 (TID-7620(Pt.I)(p.95-116)) PROGRESS REPORT ON THE INVESTIGATION OF HIGH-STRENGTH STAINLESS STEELS FOR REACTOR PRESSURE VESSELS. W. A. Saylor, A. J. Williams, and R. A. Crosby (United States Steel Corp., [Pittsburgh]).

Results of an investigation on the suitability of type 410 stainless-steel for fabrication of reactor pressure vessels are given. The fabrication technique considered involved using a corrosion-resistant hardenable steel that would permit a working stress of 40,000 psi and hardening to a minimum tensile strength of 160,000 psi throughout a thick plate. Hardenability, formability, weldability, and stress-corrosion cracking in the material were investigated. Particular attention was given to the development of suitable welding procedures; and underbead cracking and hardness, transverse butt-weld tensile, fillet-weld impact, and corrosion tests were made on welds. Results indicate that the metal is unsuitable for this application. (D.C.W.)

23913 (TID-7620(Pt.I)(p.120-5)) RÉSUMÉ OF SOME TYPICAL JOINING PROBLEMS. W. F. Brown (General Electric Co. Aircraft Nuclear Propulsion Dept., [Cincinnati]).

Two high-temperature electrical resistance heaters capable of producing temperatures of 2000 and 4000°F and an electron-beam-welding apparatus constructed from surplus x-ray equipment are briefly described. A procedure for vacuum welding capsules with the electron-beam arrangement is outlined, and a procedure for accomplishing a butt joint in sandwiched materials is discussed. (D.C.W.)

23914 (TID-7620(Pt.I)(p.126-43)) HANFORD ATOMIC PRODUCTS OPERATION WELDING REPORT, 1959-1960, TO AEC WELDING FORUM. E. B. Lavelle (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Precautions taken in welding the aluminum pressure vessel for the Plutonium Recycle Test Reactor are

described, and results of a study to determine the feasibility of welding austenitic stainless steel pipe to boron-alloy and to establish that warpage of the plates could be controlled are given. Procedures for welding titanium and Zircaloy-2 in open air and in the glove box were developed, and a technique for welding the ends of small Pu–Al pins clad in aluminum was devised. (D.C.W.)

23915 (TID-7620(Pt.I)(p.144-54)) RÉSUMÉ OF WELDING AND BRAZING DEVELOPMENTAL WORK UNDER WAY AT THE OAK RIDGE NATIONAL LABORATORY. G. M. Slaughter (Oak Ridge National Lab., Tenn.).

Work in brazing and welding at ORNL involves a study of the feasibility of joining graphite by brazing (a brazing alloy of high flowability was developed), brazing and welding of Be (Be tube-burst capsules were fabricated), investigation of the impact properties of weld heat-effected zones in A-212B steel, developmental work on an inert-arc-welding process for high vacuums, study of the welding of refractory metals, fabrication of miniature niobium in-pile irradiation tube-burst test assemblies, and development of procedures for fabricating the aluminum alloy fuel element for the ORNL High-Flux Isotope Reactor. (D.C.W.)

23916 (TID-7620(Pt.I)(p.155-8)) REPORT TO AEC WELDING COMMITTEE ON SANDIA CORPORATION WELDING FACILITIES, PROGRAMS, AND PROBLEMS. Keith E. Mead (Sandia Corp., Albuquerque, N. Mex.).

Equipment placed into operation at the Sandia Corporation welding facility is listed, and attendant efforts in quality control and material testing are mentioned. Problems presently being studied are described briefly. (D.C.W.)

23917 (TID-7620(Pt.I)(p.160-7)) STRESS-RUPTURE PROPERTIES OF HIGH-NITROGEN 308L WELD METALS. R. B. Gunia (United States Steel Corp., [Pittsburgh]).

Preliminary studies showed 308L weld metal containing Mn and N to have excellent tensile ductility, good aging heat-treatment properties, and promising stress-rupture strength. All-weld-metal and transverse stress-rupture tests were then conducted at 1000 and 1200°F with electrodes containing varying percentages of Mn and Ni. Results indicate that 308L weld metal with high N can be obtained with a partially ferritic or a fully austenitic microstructure and that 308L weld metal is suitable for joining type 347 base material for 1000 and 1200°F service. Specific recommendations on the Mn-Ni content for such service are made. (D.C.W.)

23918 (TID-7620(Pt.I)(p.168-90)) STUDIES OF RADIATION EFFECTS AND RECOVERY OF NOTCH DUCTILITY OF PRESSURE-VESSEL STEELS. J. R. Hawthorne and L. E. Steele (Naval Research Lab., Washington, D. C.).

Charpy V-notch and drop-weight test specimens of various pressure-vessel steels and weld metals were irradiated in several different nuclear and thermal environments to determine the individual effects of these irradiations on notch ductility and to investigate the effectiveness of postirradiation heat-treatment for recovery of material properties. The materials irradiations were conducted at temperatures ranging from 120 to 600°F and at neutron dosages to 2×10^{19} nvt (greater than 1.0 Mev). The irradiation of materials at reactor-coolant temperatures to exposures over 5×10^{18} nvt effected transition-temperature shifts in the order of 200°F. At temperatures of 550 to 600°F, the radiation-induced damage was significantly less. Comparison of Charpy V-notch and drop-weight nil-ductility transition-temperature shifts demonstrated excellent correspondence in the evaluation of radiation effects. Postirradiation heat-treatment of several materials revealed that recovery of notch ductility is possible. The extent of recovery was found to be strongly dependent upon irradiation temperature. Preliminary observations on the effect of the variables in recovery are discussed in relation to the nuclear environments utilized. (auth)

23919 (TID-7620(Pt.I)(p.193-205)) THE WELDING OF 2.25 Cr–0.5 Mo HEAT EXCHANGERS. C. C. Stone and R. A. Noland (Argonne National Lab., Ill.).

Equipment and procedures developed for welding the double-walled 2.25 Cr–0.5 Mo alloy tubes selected for sodium-to-water heat exchangers are described. An inert-gas-metal-arc process was adopted; a special MIG gun was developed; an Ar–O mixture was adopted for the shielding gas; and a constant-potential type power supply was chosen. Weldment tests revealed satisfactory fatigue and test properties. (D.C.W.)

23920 (TID-7620(Pt.I)(p.206-8)) NONDESTRUCTIVE METHODS FOR ESTIMATING FATIGUE DAMAGE. Lyle Donaldson (Southwest Research Inst., San Antonio).

Observations on the conditions and nature of fatigue failure in structural materials are presented, and theories proposed to explain fatigue failure are reviewed. (D.C.W.)

23921 (TID-7620(Pt.I)(p.209-16)) WELDING OF FERRITIC STEELS TO AUSTENITIC STAINLESS STEELS. G. M. Slaughter and T. R. Housley (Oak Ridge National Lab., Tenn.).

A new Inconel type electrode, BP-85, was evaluated for use in welding dissimilar metals where the joints will undergo thermal cycling. Welds of ASTM A-212B steel to type-304 stainless steel and of ASTM A-387 grade D alloy steel to type-304 stainless steel revealed excellent mechanical properties and promising thermal-cycling behavior. (D.C.W.)

23922 (TID-7620(Pt.I)(p.218-24)) THE CASE FOR AND AGAINST STRESS RELIEVING. Louis J. Larson (Allis-Chalmers Mfg. Co., Milwaukee).

Reasons commonly given for stress-relieving weldments are reviewed, and situations in which stress relieving may be advantageous, unnecessary, or even harmful are pointed out. (D.C.W.)

23923 (TID-7620(Pt.I)(p.225-42)) STRESS RELIEVING OF STAINLESS STEELS. R. A. Huseby (Smith (A. O.) Corp., Milwaukee).

Reasons for stress-relieving austenitic, ferritic, and martensitic stainless steels are given, and conditions that should be met in processing the three forms to derive good characteristics are summarized. Unfavorable changes that may occur in each of the three if proper conditions are not met are pointed out. Results of tests on the effects of heat-treatments on Charpy keyhole impact properties in various weld metals and on stress-corrosion cracking in various metals are displayed. (D.C.W.)

23924 (TID-7620(Pt.I)(p.243-50)) STRESS RELIEVING OF AUSTENITIC STAINLESS-STEEL CASTINGS. Harold C. Templeton (Alloy Steel Products Co., Linden, N. J.).

Compositional and structural differences between cast and wrought austenitic stainless-steel parts are noted. An increase in ferrite content in CF(Cr-Ni) and CF-M(Cr–Mo–Ni) alloys is noted to increase the strength of the casting, but stress-relieving treatment is seen to reduce ductility in the CF-8M alloy containing high percentages of ferrite. Some stress-relieving processes used are described, and the results of tests on the corrosion resistance of CF alloy with carbon are summarized. It is concluded

that cast austenitic materials can be treated much like wrought materials. Some specific recommendations for the processing of CF-8 alloy are made. (D.C.W.)

23925 (TID-7620(Pt.I)(p.251-7)) STRESS RELIEVING OF STEEL. R. E. Lorentz (Combustion Engineering, Inc. [Nuclear Components Engineering Dept.], Chattanooga).

Reasons for heat-treating (stress-relieving being a primary one) steels are discussed, and some practices followed with carbon, chromium, and molybdenum steels are presented. Cracking that occurred after and during forming of steel by various techniques is examined. (D.C.W.)

23926 (TID-7620(Pt.I)(p.258-69)) RESIDUAL WELDING STRESSES IN ALUMINUM ALLOYS. H. N. Hill (Aluminum Co. of America. Alcoa Research Labs., New Kensington, Penna.).

The magnitude and origin of stresses that arise in fusion welding of Al alloys are discussed, and the importance of residual stresses is examined. Effects of time and temperature on the thermal relief of residual stresses was investigated with pieces of 5456-H321 plate butt-welded together. Residual stresses were reduced 75% by holding the temperature at 525°F for 15 min, with only a 5 to 10% loss in yield strength of the base material. Residual welding stresses did not decrease buckling or impact strength, but fatigue strength was reduced for instances involving cyclic loading variations from compressive stress or no-stress to tensile stress. Stress-corrosion cracking was not enhanced by the presence of residual stresses. (D.C.W.)

23927 (WCAP-1703) FABRICATION OF THERMOELECTRIC MATERIALS BY ROTARY SWAGING. J. C. Danko, R. C. Goodspeed, G. R. Kilp, and P. V. Mitchell (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Dec. 1961. Contract AT(30-3)-500. 32p.

A powder metallurgy process for fabricating thermoelectric materials into tubular elements by rotary swaging is described. Results of swaging studies on n- and p-type PbTe and $Bi_xGe_{1-x}Te$ are reported. Results are reported on the measurements of electrical resistivity, Seebeck coefficient, and thermal conductivity of n- and p-type PbTe swaged annular elements. The compatibility of lead telluride and bismuth germanium telluride with a variety of cladding materials is reported. Data are presented for several combinations of thermoelectric and cladding materials as follows: representative photomicrographs of the thermoelectric material–clad interface of swaged and heat treated specimens, and reaction zone thickness values plotted versus time at constant temperature. (auth)

23928 (EURAEC-511) RESEARCH ON THE APPLICATION OF THE VERTICAL SUBMERGED ELECTROCONDUCTIVE SLAG WELDING PROCESS TO THICK STEEL SHEETS UNDER WORKSHOP OR SITE CONDITIONS. STUDY NO. 360. FLAME CUTTING TESTS ON A 200 MM THICK STEEL SHEET. (Chantiers de l'Atlantique Penhoet-Loire, Paris). Sept. 24, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 054-61-12-RDF. 13p. A translation.

It was found that the cutting proceeds without difficulty without preheating. The quality was better in vertical than in horizontal position; however, both were satisfactory. (J.R.D.)

23929 (EURAEC-593) APPLICATION OF THE UPRISING ELECTROSLAG WELDING PROCESS ON THICK STEEL PLATES UNDER WORKSHOP OR BUILDING YARD CONDITIONS. Special Report No. 3. (Chantiers de l'Atlantique Penhoet-Loire, Paris). Dec. 11, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 054-61-12-RDF. 18p. A translation.

The distribution and evolution of deformations and temperatures during electroslag welding of 200-mm-thick Mn–Mo plates are described. (J.R.D.)

23930 CERAMIC-METAL BONDING STABLE IN EXCESS OF 2248°K. A. G. Buyers (Hughes Aircraft Co., Malibu, Calif.). J. Am. Ceram. Soc., 46: 244-5(May 21, 1963).

A ceramic-metal bond between Ta and stabilized zirconia that is capable of structural stability at temperatures in excess of 2248°K is described. The apparatus used for creating the Ta-zirconia bond consisted of a 20-kw high-frequency converter that supplied power to a flat water-cooled copper induction coil enclosed within a quartz envelope fitted with an inert gas inlet. Bonding intermediates, formed spontaneously at approximately 2248°K, were identified for seals using zirconia stabilized with a variety of oxides by means of x-ray diffraction powder patterns. (P.C.H.)

23931 END SEALING OF EXPERIMENTAL S.A.P. FUEL ELEMENT CANS BY PRESSURE WELDING. K. H. Wollaston. Welding Metal Fabric., 30: 319-23(Aug. 1962).

Results of exploratory work aimed at developing a method of end sealing S.A.P. 895 tubes (10 per cent oxide content) confirmed that neither argon-arc welding, torch brazing, nor furnace brazing can be considered suitable methods for this operation. Strength of joints produced by all three processes was insignificant, and severe internal fissures and external blisters formed in the material. Resistance spot welding showed some promise, but welds made under a wide range of conditions showed aluminum segregation and weld line porosity, and the extension of the method to seam welding would present problems associated with distortion of the workpiece by electrode pressure. However, by hot pressure welding under defined conditions, it was proved possible to produce end-sealed tubes with sound, helium leak-tight joints capable of withstanding internal hydraulic pressures of more than 2000 lb per sq in. at room temperature. The major disadvantage of the method is that a reduction of tube wall thickness in the region of the cap is inevitable unless the tube wall could be made thicker in the region where the weld was to be performed. On the other hand, the process is simple to operate, requires only simple equipment, and on a production scale it could be automated. (auth)

23932 ELECTRODES FOR WELDING HIGHER STRENGTH REACTOR PRESSURE VESSEL STEELS. A. Cowan. Welding Metal Fabric., 30: 386-94(Oct. 1962).

The program for the development of steels of tensile strength of 36 to 40 tons/in.^{2} is described briefly, and the development of welding electrodes for these steels is considered in detail. The properties required of the weld metal are described. Electrodes were developed by three manufacturers for 3-in.-thick plates of 36 tons/in.^{2} steel, and assessments of them were made under conditions likely to be applied in the fabrication of a reactor pressure vessel. The mechanical properties of the weld metal and joints are described for each electrode. (D.L.C.)

23933 ALUMINUM ALLOY REACTOR TANKS. D. Slater, A. A. Townsend, and R. N. Saunders. Welding Metal Fabric., 30: 422-33(Nov. 1962).

Experience in the manufacture of these reactor vessels has shown that it is possible to produce structures in welded aluminum alloy of a complexity as great as that at times employed in steel and stainless steel constructions,

this despite the fact that the surface characteristics and welding response of aluminum and its alloys are widely different from those of other materials. Advances in welding technique and intelligent modification of commercially available welding equipment has enabled welds of satisfactory quality in seemingly impossible situations to be made, although with some difficulty. The exercise has shown that the expenditure of time in construction would appear to be out of all proportion to the weight of metal involved, and there is added incentive to hasten the work of determining the precise significance of such welding defects as are commonly met in practice and which are so expensive to remove, and of determining the significance of filler alloy composition and crevice construction on the service behavior of structures in aluminum–magnesium alloys. (auth)

23934 METHODS OF MAKING THIN REINFORCED DIAPHRAGMS AND IN DIAPHRAGMS MADE ACCORDING TO THESE METHODS. Francis Boulet, Pierre Plurien, Maurice Quenault, and Roger Rigot (to Commissariat a l'Energie Atomique). U. S. Patent 3,089,235. May 14, 1963. Priority date May 4, 1957, France.

A method is described for making a thin reinforced microporous diaphragm from a thin sheet of aluminum metal or aluminum alloy. The method comprises forming on one face of the sheet stiffening projections with a tool, subjecting the other (smooth) face to an anodic oxidizing treatment, and stopping the treatment at the point where the sheet but not the projections are oxidized. (D.L.C.)

23935 PROCESS OF MANUFACTURING NUCLEAR FUEL. John G. Lewis and Harold A. Ohlgren (to American Metal Products Co.). U. S. Patent 3,089,785. May 14, 1963. Filed Mar. 23, 1960.

A process is given for producing coated graphite particles containing a dispersion of uranium carbide. The process comprises contacting a finely divided carbonaceous material (preferably graphite) with gaseous UF_6, raising the temperature to ≥1000°C at 1 to 2 atm to cause the formation to UF_4, and further heating to 2000 to 2500°C at 1 to 10μ Hg pressure to form UC. The resulting particles may be coated by a metal vapor or by reaction of a metal halide vapor with a reducing gas. (D.L.C.)

Properties and Structure

Refer also to abstracts 24623 and 24639.

23936 (AAEC/E-105) GRINDING STUDIES ON BERYLLIUM OXIDE POWDER. K. D. Reeve and E. J. Ramm (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1963. 16p.

Inhomogeneities in beryllium oxide observed in the powder and in cold pressed and sintered specimens were removed by grinding the powder prior to fabrication. All grinding procedures reduced the densities obtained under standard sintering conditions, but some grain refinement was noted on sintering after short grinding periods. These effects are related to the introduction of alumina and silica impurities during ball milling. There is some indication that short grinding periods improve the strength of sintered specimens. (auth)

23937 (AD-403757) PREPARATION AND EVALUATION OF HIGH PURITY BERYLLIUM. Quarterly Progress Report, October 2, 1962–January 1, 1963. G. E. Spangler, M. Herman, E. J. Arndt, D. B. Hoover, and V. V. Damiano (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract NOw-62-0536-d. 20p. (Q-B1933-5)

Work is being carried out to produce high-purity Be and to study its deformation and fracture characteristics. The zone melting of one one-inch-diameter vacuum-cast and extruded bar was completed. A total of 11 passes was made through this bar at a rate of one-half inch per hour. A single-crystal specimen of a Cu–Be alloy was tested in tension with the crystal oriented for basal glide. A tensile test was also performed on a nine-pass single crystal oriented with the c-axis parallel to the tensile axis. Results indicated that purification reduced the stress for twinning by one half. A sample of the Be–5 wt.% Cu crystal was hot swaged at 525°C. The as-swaged wire was recrystallized and showed a definite $(1\,0\,\bar{1}\,0)$ wire texture. Bend tests of the wire annealed at 750 and 900°C showed the same behavior exhibited by unalloyed hot-swaged Be. Metallographic studies of the inter-crystalline fracture phenomenon observed in hot-swaged wire were continued. Polycrystalline beryllium specimens, prepared by hot rolling zone-refined single crystals, were studied using electron transmission microscopic techniques. Be^7 was used as a tracer to study self-diffusion in specimens prepared from a zone-refined beryllium single crystal. (M.C.G.)

23938 (AERE-M-1199) PHONON FREQUENCY DISTRIBUTION IN GRAPHITE. D. H. Saunderson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1963. 8p.

Calculations of the frequency distribution of lattice vibrations in graphite by Yoshimori, Kitano, and Baldock are discussed and compared with recent experimental measurements using neutron inelastic scattering techniques. (auth)

23939 (AFSWC-TDR-62-143(Vol.II)) OPTICAL PROPERTIES OF URANIUM. Final Report. John C. Stewart (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 1963. Contract AF29(601)-4574. 55p.

The effect of the coherent Doppler shift on the change in radiative flux per unit temperature gradient for the optically thick limit is considered. The solutions of nongrey Milne problems are also presented. Screening constants for the two-electron case are tabulated. (auth)

23940 (AGN-8082) RUBIDIUM/CESIUM EVALUATION PROGRAM. Quarterly Progress Report, January 1–March 31, 1963. C. R. Fisher and P. Y. Achener (Aerojet-General Nucleonics, San Ramon, Calif.). Apr. 30, 1963. Contract AT(04-3)-368. 19p.

The characteristics of Rb and Cs at temperatures up to about 2000°F are being evaluated. The program includes studies of the boiling heat transfer and two-phase flow characteristics and measurements to determine the latent heat of vaporization, density, specific heat, viscosity, thermal conductivity, and electrical resistivity of the liquid phases of Rb and Cs. A discussion of some of the details of fabrication of the test section for the heat transfer loop is included. Operational details in the thermodynamic properties study are also described. (auth)

23941 (ANL-FGF-364) ROOM TEMPERATURE LATTICE CONSTANTS OF ALLOYS OF PLUTONIUM IN ALPHA-URANIUM. A. F. Berndt (Argonne National Lab., Ill.). June 29, 1962. Contract [W-31-109-eng-38]. 18p. (UAC-6645)

Lattice constants of solid solutions of plutonium in

alpha-uranium were measured at room temperature, 25 ± 2°C, by the Debye-Scherrer method, from samples prepared by furnace cooling from 400°C. The lattice constants a_0 and c_0 were found to increase and b_0 to decrease with increased plutonium content, until a concentration of about 15 wt % Pu was reached. The lattice constants of the 15 wt % Pu alloy were: $a_0 = 2.8625$ Å, $b_0 = 5.8562$ Å, $c_0 = 4.9631$ Å. (auth)

23942 (ARF-B6001-3) HIGH-TEMPERATURE OXIDATION PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS. Bimonthly Report No. 3, January 13, 1963–March 12, 1963. John J. Rausch and F. C. Holtz (Illinois Inst. of Tech., Chicago, Armour Research Foundation). Apr. 8, 1963. Contract N600(19)-59182. 16p.

Basic pack siliconizing processing variables such as time, temperature, edge and surface preparation, activator concentration, and powder size were investigated to optimize oxidation life and coating adherence for thin sheet material. Fifteen vanadium–niobium alloy compositions were pack siliconized and oxidation tested. Minimum life was established at about 150 hr at 2200°F for each of the alloys. (auth)

23943 (ARF-B6007-2) DISPERSION-STRENGTHENED VANADIUM ALLOYS. Bimonthly Report No. 2, February 14, 1963–April 13, 1963. F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 8, 1963. Contract N600(19)-59567. 16p. (AD-404100)

Arc-melting and powder metallurgy techniques are being used to incorporate fine, refractory dispersants in V–Nb base alloys in order to improve their long-time elevated-temperature strength properties. Solution annealing and aging studies of arc-melted alloys containing Hf or Zr in combination with C indicate that the Hf carbide phase is the more stable. The hydride process was used to obtain powders of V-60 wt % Nb-1 wt % Ti, to which fine oxide or carbide powders were added. After blending, cold-compacting, sintering at 2800°F, and annealing at 2000 and 2400°F, specimens containing alumina and thoria exhibited a high degree of reactivity with the alloy base. Improved stability was noted in the alloys containing ceria, lanthana, yttria, Hf carbide, and Zr carbide. (auth)

23944 (ARL-62-397) RESEARCH ON THE BEHAVIOUR OF TANTALUM AND TANTALUM BASE ALLOYS AT HIGH TEMPERATURES. Per Kofstad (Sentralinstitutt for Industriell Forskning, Blindern, Norway). Apr. 1, 1962. 11p. (AD-281882)

Studies were made on the oxidation behavior of Ta at 300 to 550°C, x-ray diffraction and metallography of metallic oxide phases (suboxides) of Ta and Nb, which are reaction products in the oxidation of the metals, and oxidation of Ta–10% W at 700 to 1300°C. X-ray diffraction studies of Nb sheets showed that NbO_x has a tetragonal structure with dimensions $a = 3.38_7$ Å, $c = 3.27_4$ Å, and $c/a = 0.97$. Oxidation of Ta at temperatures up to 500°C showed the formation of an orthorhombic metallic oxide, TaO_y. Over long periods of time below 450°C, the oxidation of Ta conforms with a parabolic behavior. During the initial stages, the oxidation of Ta–10% W also follows an approximate parabolic behavior. (P.C.H.)

23945 (ASD-TDR-63-232) COATINGS FOR TANTALUM-BASE ALLOYS. J. B. Hallowell, D. J. Maykuth, and H. R. Ogden (Battelle Memorial Inst., Columbus, Ohio). Feb. 28, 1963. Contract AF33(657)-7909. 80p.

Silicide coatings, applied by pack cementation, were evaluated on a variety of Ta alloys including Ta–10W, Ta–30Nb–7.5V, and Ta–8W–2Hf. Modification of the silicide, by diffusion with the underlying substrates, resulted in significant differences in oxidation behavior. Similar effects were obtained by incorporating Al, B, and Mn additions in the silicide coating. Of the modifiers studied, V was found to be most beneficial in improving the protective life of silicide coatings at low as well as high temperatures. Straight silicide coating of Ta–30Nb–7.5V alloy had no detrimental effect on room-temperature properties and provided useful lives in dynamic as well as static oxidation testing at temperatures to 3000°F. Modifications of the silicide with B and V show further improvements in static oxidation performance at temperatures from at least 1800 through 2900°F. (auth)

23946 (BMI-X-10039) FISSION-PRODUCT RELEASE FROM FUEL-ELEMENT CLADDINGS. Quarterly Progress Report, January–March 1963. Fitz R. Winslow, Thomas S. Elleman, George G. Cocks, Josef Bugl, and Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 17p. (EURAEC-625)

Seven series of out-of-pile experiments to study xenon-133 release from foils of iron-chromium alloy specimens impregnated with fission recoils were performed at 800, 1000, and 1200°C. Release was found to be time, temperature, and concentration dependent. Significant release of xenon-133 was observed at 1100 and 1200°C during in-pile experiments. Evidence of gas-bubble formation was obtained by electron-transmission studies. Redissolution of gas in the bubbles or the freeing of trapped gas atoms was suggested by the gas release behavior. Postirradiation heating experiments were performed with iron-nickel alloy and gold foils. The xenon-133 release behavior is similar to that shown by the iron-chromium alloy. In studies of solid fission-product diffusion the recoil distribution of cerium-141 in a plate of the iron-chromium alloy was found to be linear with distance. At 1000°C, diffusion coefficients of 3.54×10^{-10} for ruthenium-103 and 5.43×10^{-11} cm^2/sec for cerium-141 and zirconium-95–niobium-95 were determined. Ruthenium is much more mobile than the other fission products at this temperature as well as at 1200°C. (auth)

23947 (GA-3585) A PROGRAM OF BASIC RESEARCH ON MECHANICAL PROPERTIES OF REACTOR MATERIALS. Summary Report, October 1, 1961 through September 30, 1962. T. A. Trozera, J. L. White, and R. H. Chambers (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Nov. 10, 1962. Contract AT(04-3)-167. 50p.

Progress is reported in research on mechanical properties of reactor materials. Topics covered include: deformation and fabrication characteristics of reactor materials, tension experiments on ultrapure tantalum, prestrain experiments and surface observations on tantalum crystals, stored-energy-release spectra in deformed iron and copper, calorimeter techniques for measuring stored-energy release, theory of α dislocation-relaxation peak in cold-worked niobium single crystals, amplitude-dependent internal friction and its connection with dislocation-relaxation oscillations, and isostructural measurement of the activation energy of torsional creep. (M.C.G.)

23948 (IS-521) THE PREPARATION AND PROPERTIES OF DISTILLED YTTRIUM. C. E. Habermann and A. H. Daane (Ames Lab., Ames, Iowa). [July 27, 1962]. Contract [W-7405-eng-82]. 12p.

Distillation procedures used for purifying Y metal, pro-

ducing metal containing less than 150 ppm O and lower concentrations of most of the other common impurities, are discussed. Some of the physical and mechanical properties of the distilled Y indicate: a melting point of 1510°C; a solid state transformation at 1459°C obtained from high-temperature resistivity data; a Rockwell H hardness of 60; and improved rolling and swagging characteristics. (auth)

23949 (IS-536) THE THALLIUM–INDIUM PHASE DIAGRAM AS A FUNCTION OF COMPOSITION, TEMPERATURE, AND PRESSURE. R. W. Meyerhoff and J. F. Smith (Ames Lab., Ames, Iowa). Aug. 21, 1962. Contract W-7405-eng-82. 26p.

The Tl-rich region of the Tl–In phase diagram was determined from atmospheric pressure to 5.5 kbars primarily from electric resistivity data obtained as a function of composition, temperature, and pressure. Corroborative x-ray diffraction data were taken at atmospheric pressure. Extrapolation of the results to high pressures indicates that a triple point occurs among three solid allotropes of Tl at 162°C and 35.8 kbars. The high pressure phase was found to be continuous with the fcc phase observed at atmospheric pressure for Tl containing 40 to 77 at. % In. This indicates that the crystal structure of the high pressure allotrope of Tl is fcc. The remaining two phases in equilibrium at the triple point are continuous with the hcp low temperature phase and the bcc high-temperature phase observed for pure Tl at atmospheric pressure. A revised phase diagram for the Tl–In system at atmospheric pressure is also proposed. (auth)

23950 (IS-538) PHASE DIAGRAM AND THERMODYNAMIC PROPERTIES OF THE YTTRIUM–ZINC SYSTEM. P. Chiotti, J. T. Mason, and K. J. Gill (Ames Lab., Ames, Iowa). [Aug. 27, 1962]. Contract [W-7405-eng-82]. 25p.

Thermal, metallographic, and vapor pressure data were obtained to establish the phase boundaries and the standard free energy, enthalpy, and entropy of formation for compounds in the Y–Zn system. Three compounds with stoichiometric formulas of YZn, YZn_2, and Y_2Zn_{17} melt congruently at 1105, 1080, and 890°C, respectively. Four compounds with stoichiometric formulas of YZn_3, YZn_4, YZn_5, and YZn_{11} undergo peritectic reactions at 905, 895, 870, and 685°C, respectively. Three eutectics exist in the system with the following eutectic temperatures and Zn contents in wt %: 875°C, 23.2% Zn; 1015°C, 51% Zn; 865°C, 82% Zn. The YZn_2 phase undergoes an allotropic transformation. In the two-phase YZn_2–YZn alloys the transformation gives a weak thermal arrest at 750°C, whereas in the two-phase YZn_2–YZn_3 alloys no thermal arrest is observed, and the transformation occurs over a temperature range below 750°C. At 500°C the free energies of formation per mole vary from −18090 for YZn to −53430 for YZn_{11}, and corresponding enthalpies vary from −24050 to −92080. The free energies and enthalpies per gram atom as a function of composition show a maximum for the YZn_2 phase; the 500°C values are −9580 and −13180, respectively. (auth)

23951 (JPL-TR-32-360) STRUCTURAL TRANSFORMATION IN PYROLYTIC GRAPHITE ACCOMPANYING DEFORMATION. W. V. Kotlensky and H. E. Martens (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Nov. 1, 1962.

Electron microscopy and x-ray-diffraction techniques were used to follow the structural changes that accompany deformation in one lot of pyrolytic graphite when stress is applied parallel to the substrate direction. Basal slip and an increase is applied parallel to the substrate direction. Basal slip and an increase in preferred orientation account for deformations up to 20%. Fracture across the basal planes with subsequent basal slip and an increase in porosity and a very slight increase in preferred orientation account for deformations above 20%. Rows of etch pits, which may be dislocations parallel to the substrate direction, were observed in a specimen heated without load to 3000°C. (auth)

23952 (LADC-5384) LOW-TEMPERATURE LATTICE PARAMETERS OF THORIUM–CERIUM ALLOYS. James T. Waber (Los Alamos Scientific Lab., N. Mex.); I. Rex Harris, and G. V. Raynor (Birmingham. Univ., England). [1962]. Contract [W-7405-eng-36]. 31p.

The lattice parameters of a series of fcc alloys of Ce and Th were measured at 93 and 298°K and estimated for 171°K. Substantial deviations, y, from Vegard's Law were observed. Although y was negative at the two higher temperatures, it was positive and large at the lowest temperature. A variety of models, which have been proposed in the past, were considered, and the calculated values of y were compared with the observed values. The best agreement was achieved with values computed with Friedel's equation. (auth)

23953 (LADC-5466) FURTHER CONSIDERATION OF THE ANOMALOUS THERMAL EXPANSION OF DELTA PHASE PLUTONIUM ALLOYS. K. A. Gschneidner, Jr., R. O. Elliott, and J. T. Waber (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 41p.

It is proposed that the negative coefficient of thermal expansion of pure delta Pu and of delta-stabilized Pu alloys depends upon the electron concentration, η. As the electron concentration is lowered by increasing the concentration of alloying additions of Al, Zn, Zr, In, and Ce, the negative coefficient of expansion becomes less negative and finally reaches zero at the critical value, η^*, of 4.74. At lower η values the coefficient of thermal expansion is positive. Several models were examined, and it appears that either the Varley or the similar Rocher-Friedel, Zachariasen, and Kmetko models could be used to explain the observed behaviors. A new tactic for estimating the valence of a metal is also described. (auth)

23954 (LADC-5478) AN ABSORPTION CONTRAST EFFECT IN BCC METALS. S. E. Bronisz and Dana L. Douglass (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 6p.

Contrast figures of unusual form were observed in Mo and Nb among other bcc metals by transmission electron microscopy. The figures appear to be caused by the anomalous absorption of electrons. (auth)

23955 (NMI-2802) SUMMARY OF PROGRESS ON THE STUDY OF BETA TREATMENT OF URANIUM, SEPTEMBER 1 TO NOVEMBER 30, 1960. R. B. Russell (Nuclear Metals, Inc., Concord, Mass.). Dec. 27, 1960. Contract AT(30-1)-1565. 69p.

Studies were made of the variables affecting the growth index (G_3) and grain size of beta-treated uranium. The effect of time and temperature in the beta phase on G_3 was somewhat clarified. The range of beta treatment conditions was a heating of 2 to 64 min in molten salt at 690 to 760°C and oil quenching. Both bare and sealed discs were studied. It was found that G_3 is affected by time only by small increments toward $G_3 = 0$ for 2 to 5 min; after this time G_3 is not expected to increase significantly. The G_3 values in discs protected from molten salt increase during this period by the same amount as bare discs. An investigation of thermal data for $1\frac{7}{8}$-in.-dia rod and for 3-in. OD

by $2\frac{1}{2}$-in. ID tube showed that there is little difference in cooling rate between a warm (55°C) oil quench and a room-temperature oil quench, whereas the cooling rate in warm (55°C) water is definitely less than in cold (13°C) water. Grain size and G_3 data are presented for a $1\frac{7}{8}$-in.-dia cold-(12°C) water-quenched rod and a $1\frac{7}{32}$-in.-dia 23°C oil-quenched rod. (P.C.H.)

23956 (NMI-2806) PROGRESS ON THE STUDY OF BETA TREATMENT OF URANIUM, DECEMBER 1, 1962 TO MARCH 31, 1962. R. B. Russell and A. K. Wolff (Nuclear Metals, Inc., Concord, Mass.). Apr. 13, 1962. Contract AT(30-1)-1565. 41p.

The effects of composition (ingot vs dingot), prior delta condition, geometry, heat treatment, and applied stress on cooling rate, grain size, and texture are described for U rods and tubes. Investigations were also made on the effect of stress and free surfaces on the texture distribution. Cooling rates were obtained for the quenching of 3- and 1.5-in. OD tubes with a 0.5-in. ID in different media, including a comparison of the rates between room temperature Houghto K and Poco No. 2 oils. The quenching rate in Houghto K was slightly greater. A study of 1.5-in. OD by 0.5-in. ID as-extruded dingot tube quenched from the beta phase into different media showed that the FEDC grain size of water-quenched tube varied between A-6 and A-7, that oil quenching produced grains between C-4 and C-5, and that the air-cooled tube had B-2 to B-3 grain size. Both ingot and dingot were similar in exhibiting severe radial texture penetration after water quenches. In general, both ingot and dingot have the same range of radial G_3 values, but with different G_3 distributions. (P.C.H.)

23957 (NMI-7247) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission, for the Period January 1, 1962 through January 31, 1962. S. Isserow, R. W. Anderson, W. L. Larson, E. F. Jordan, and W. J. Richmond (Nuclear Metals, Inc., Concord, Mass.). Mar. 13, 1962. Contract AT(30-1)-1565. 26p.

A continuing effort is directed toward the establishment of procedures for brazing end caps on HWCTR metal tubes. Voids can be minimized by controlling the radial clearance between the plug and cladding, and by directional solidification. A modified beta treatment method is being explored. Comparative grain size determinations on extruded tubes of uranium, U-0.08 wt % Si, and U-0.05 wt % Cr-0.10 wt % Mo indicated that all three materials quenched from the beta treatment temperature recrystallized during subsequent heating to 600°C, acquiring a finer grain size. Hot hardness data from 20 to 600°C indicate that the phases are not in a stable condition as beta treated but undergo changes during subsequent heating. Processing of two restraint tubes and the U-0.3 wt % Al-0.5 wt % Si tube is completed. (auth)

23958 (NP-12770) ELECTROMECHANICAL PROPERTIES OF THREE EXPERIMENTAL LEAD ZIRCONATE–LEAD TITANATE CERAMIC COMPOSITIONS. T. B. Weston (Canada. Dept. of Mines and Technical Surveys. Mines Branch). July 27, 1962. 28p.

Available as Can. Dept. of Mines and Tech. Surveys, Mines Branch Research Report R-100, $0.75.

Three experimental piezoelectric compositions in the lead titanate-lead zirconate series were produced, using conventional ceramic fabrication techniques. Long-period grinding of the constituents in ball mills made it possible to employ sintering temperatures lower than those previously reported, but there was some loss of lead oxide during fabrication and impurity pickup during grinding was substantial. The finished ceramic samples proved difficult to pole, but development of a suitable poling technique yielded piezoelectric properties only slightly poorer than the best values reported in the literature for similar compositions, generally produced by more elaborate methods. Although some unexpected changes of composition during fabrication were observed, it was possible to draw some conclusions regarding the effect of minor chemical modification, including the addition of niobia, on the electromechanical properties. (auth)

23959 (NP-12793) DISPERSION STRENGTHENED NICKEL-BASE ALLOYS. Progress Report No. 1, March 1 to April 30, 1963. A. S. Bufferd, R. C. Nelson, and N. J. Grant (New England Materials Lab., Inc., Medford, Mass.). May 15, 1963. Contract N600(19)59891. 8p.

Dispersion strengthened Ni-base alloys (80% Ni–20% Cr) were prepared by the mechanical mixing of Nichrome and thorium oxide powders. The compositions and principal fabrication variables of 5 extruded alloys are tabulated. (P.C.H.)

23960 (NP-12796) MEASUREMENTS OF THERMAL CONDUCTIVITY AND ELECTRICAL RESISTIVITY OF AN HIGHLY ANISOTROPIC ZT-TYPE GRAPHITE AT HIGH TEMPERATURES. Research Report No. C-16. J. N. Pike (Union Carbide Corp. Parma Research Lab., Ohio). Apr. 22, 1963. Contract DA-30-069-ORD-2787. 36p.

Measurements of with-grain and against-grain thermal conductivities and electric resistivities were made (over the temperature range 1200 to 2800°K) of samples of a bulk density 2.15, controlled orientation, ZT-type graphite. The anisotropy in electric resistivity $\rho_\perp/\rho_\parallel$ drops smoothly from its room temperature value of 7.0 to a value of 4.5 at 2400°K and appears to level off at higher temperatures. At high temperatures, the anisotropy in thermal conductivity $K_\parallel/K_\perp$ is 20 to 30% lower than $\rho_\perp/\rho_\parallel$. At 2400°K, typical thermal conductivities are $K_\parallel = 0.6$ watt cm^{-1} deg^{-1}, $K_\perp = 0.15$ watt cm^{-1} deg^{-1}. Total emissivities were also measured on the assumption that spectral emissivity at the pyrometer wavelength is 1.0. (auth)

23961 (ORNL-TM-542) THE EFFECT OF IMPURITIES ON MECHANICAL TWINNING AND DISLOCATION BEHAVIOR IN BODY-CENTERED CUBIC METALS. J. O. Stiegler and C. J. McHargue (Oak Ridge National Lab., Tenn.). May 28, 1963. Contract W-7405-eng-26. 37p.

Dislocation substructures, as observed by transmission electron microscopy, are reported for materials that twin during deformation and are contrasted with substructures in materials that fail to twin. Differences are interpreted in terms of an increased lattice frictional stress and a reduced ability of dislocations to cross slip in high alloys or during low-temperature deformation. Mechanisms by which the effects alter the twinning behavior are discussed. There is evidence that the stacking fault energy is not lowered by the alloying action. It is further argued that stress concentrations resulting from the altered dislocation configuration are responsible for the enhanced twinning in the alloys. In addition, a raised cleavage strength and increased ability to hold interstitials in solution may act to prevent brittle fracture. The inhibiting effect which interstitials exert on twinning, is explained in terms of interstitial precipitates providing sites where dislocation tangles may form and thus break up potential centers of stress concentration. Transmission electron microscope observations of a Nb–40 wt % V alloy are described that show that the twins generally run entirely across the grains in lightly

deformed materials. The observations suggest that solid solution alloys of the refractory metals can be developed that have superior strength to the pure metals, and, because of their ability to twin, may be fabricated readily at room temperature. (P.C.H.)

23962 (TID-16906) THERMAL STUDIES OF $Ca_xBa_{1-x}TiO_3$. Donald D. Glower and Duane C. Wallace (Sandia Corp., Albuquerque, N. Mex.). Sept. 1962. Contract [AT(29-1)-789]. 16p. (SCDC-2886)

Measurements were carried out on $Ca_xBa_{1-x}TiO_3$ ceramics for which $0 \leq x \leq 0.19$. The thermal diffusivity was measured from −60 to 230°C and the thermal conductivity was measured from 40 to 150°C. The electrical properties were also measured as a function of temperature. The velocities of dilatational elastic waves were measured for these ceramics at room temperature. The increase in the thermal resistance with increasing x-value was accounted for within the limits of error of the measurements by using a Debye distribution for the phonon spectrum and attributing the phonon scattering to the mass difference between the Ba atoms and the substitutional Ca atoms. (auth)

23963 (TID-18612) DETERMINATION OF TRUE STRESS-STRAIN PROPERTIES OF BRITTLE MATERIALS TO OVER 5000°F. Eighth Monthly Report. Frank J. Digesu and C. D. Pears (Southern Research Inst., Birmingham, Ala.). Apr. 29, 1963. Contract AT(40-1)-2694. 5p.

Attempts were made to improve precision in strain measurements of brittle materials caused by optical problems introduced by lateral displacement of the flags. Apparent change in the gage length and errors from the lateral displacement were reduced from a possible 10% to 1/9% by adjustment of the plane of the lower universal or by using precision guides on the lower end of the load train. (P.C.H.)

23964 (TID-18619) INVESTIGATION OF SPECIFIC VOLUMES OF LIQUID METALS AND ALLOYS. PHASE EQUILIBRIA STUDIES OF ALKALI–ALKALINE EARTH METAL SYSTEMS. Combined Report No. II. Frank A. Kanda and Douglas V. Keller (Syracuse Univ., N. Y. Research Inst.). May 1963. Contracts AT(30-1)-2731 and AT(30-1)-1910. 62p.

Investigations were made on phase equilibria in the Na–Sr and Ba–Na systems and the structure of intermetallic compounds in Mg–Sr, Ba–Mg, Ba–Li, and Li–Sr. A_6B_{23} type compounds were observed in the intermetallic binary systems except in the Ba–Li system. (P.C.H.)

23965 (TID-18632) A STUDY OF THE IB-IIB BETA PHASE ALLOYS. Annual Progress Report, May 1, 1962 to April 1, 1963. Leonard Muldawer (Temple Univ., Philadelphia). Contract [AT(30-1)-2082]. 24p.

Gradual disordering of Ag–Au in $AgAuCd_2$ and $AgAuZn_2$ and of Cu–Au in $CuAuZn_2$ was studied by x-ray diffraction. Precision lattice constant measurements over an extended composition range for β brass were made and gave $\Delta a/\Delta c = 0.00185$ A/% Zn. The low symmetry phase in $AgAuCd_2$ is shown not to exist. Various equipment for optical studies on the β-brass was designed and assembled. A study of the existing data indicates that the theoretical understanding must be based on interband transitions and plasma oscillations. (P.C.H.)

23966 (TID-18637) AN EVALUATION OF THE ROLE OF DEFORMATION TWINNING IN THE PLASTIC DEFORMATION OF ZIRCONIUM. Quarterly Progress Report No. 5. R. E. Reed-Hill (Florida. Univ., Gainesville. Engineering and Industrial Experiment Station). Jan. 1963. Contract AT(38-1)-252. 58p.

A study was made of the kink bands that were observed in both Zr and Zircaloy-2. They were shown to be associated with basal slip and not prismatic slip. Transverse specimens of Zr deformed at elevated temperatures (540°C) contained the greatest number and most sharply defined kink bands. The ease with which kink bands formed in these specimens may account for their observed lack of twins. At room temperature kink bands were found in both tensile and compressive specimens. At lower temperatures the kink-band boundaries were always less sharply defined. Kink-band boundaries were frequently associated with grain corners, and an explanation for this observation is proposed. A preliminary investigation of the feasibility of the use of the polarized-light microscope to determine the pole figure of a hexagonal metal is discussed. The method is based on a study of the surface distribution of basal-plane traces in metallographic specimens. Wah Chang arc-melted sponge Zr plate was used as a material to test the method. The basal-plane trace distributions of this material are reported. Evidence is presented to explain why prestraining at the temperature of liquid N_2 increases the ductility of transverse Zr specimens at room temperature. Deformation at room temperature nucleated almost exclusively only $\{1\,0\,\bar{1}\,2\}$ twins. Prestraining at liquid N_2 temperature nucleated, in addition to $\{1\,0\,\bar{1}\,2\}$ twins, a large number of $\{1\,1\,\bar{2}\,1\}$ twins. During subsequent room-temperature deformation twins nucleated during the prestrain grew. The presence of $\{1\,1\,\bar{2}\,1\}$ twins in the structure permitted the metal to undergo deformation at room temperature by an additional basic mode of deformation which was not available without the prestrain. Also, the contribution of the $\{1\,1\,\bar{2}\,1\}$ twins to the deformation was large because the twinning shear of $\{1\,1\,\bar{2}\,1\}$ twins as previously reported was 0.63. This shear was almost four times larger than that in $\{1\,0\,\bar{1}\,2\}$ twins. The metallographic procedures used are reported. (auth)

23967 (TID-18638) AN EVALUATION OF THE ROLE OF DEFORMATION TWINNING IN THE PLASTIC DEFORMATION OF ZIRCONIUM. Quarterly Progress Report No. 6. R. E. Reed-Hill (Florida. Univ., Gainesville. Engineering and Industrial Experiment Station). Mar. 1963. Contract AT(38-1)-252. 37p.

Second order twinning is most pronounced in $\{11\bar{2}2\}$ twins and seldom observed in $\{10\bar{1}2\}$ on $\{11\bar{2}1\}$ twins. Evidence shows that this is a result of the nature of the lattice reorientations that take place during twinning. Only in $\{11\bar{2}2\}$ twins is the lattice reoriented into a position with respect to the stress axis that is favorable for second order twinning. A representation of the basal plane pole figure of arc-melted sponge zirconium is presented. This pole figure is deduced from a statistical analysis of the distribution of basal plane traces of the grains in metallographic specimens. The axis of bending at kink band boundaries is determined to be approximately $(10\bar{1}0)$. This result is obtained by forming kink bands in a specimen at 540°C and then deforming it slightly in liquid nitrogen in order to nucleate twins. With the aid of these twins, the lattice can be oriented on both sides of a bend plane. (auth)

23968 (TID-18669) AN EVALUATION OF THE ROLE OF DEFORMATION TWINNING IN THE PLASTIC DEFORMATION OF ZIRCONIUM. Quarterly Progress Report No. 7. Robert E. Reed-Hill (Florida. Univ., Gainesville. Engineering and Industrial Experiment Station). May 1963. Contract AT(38-1)-252. 44p.

The incidence of twinning in polycrystalline Zr was found to be both temperature- and strain-rate-dependent. More twinning modes become strongly active at higher strain rates and lower temperatures. At a slow tensile strain rate (0.016 min^{-1}), deformation occurs primarily by: slip at elevated temperatures (540°C); prism slip and (1012) twinning at room temperature; and prism slip, (1012), and (1121) twinning at low temperatures (77°K). At 540°C, kink band formation apparently replaces twinning as a means of deformation in grains unfavorably oriented for prism slip. Twin nucleation in polycrystalline Zr is evidently more difficult than twin growth. Second order twinning occurs when the lattice of the primary twins has the proper orientation with respect to the stress axis to form twins of the observed second order modes. (P.C.H.)

23969 (UCRL-10365) ON THE NATURE OF STRAIN HARDENING IN POLYCRYSTALLINE ALUMINUM AND ALUMINUM–MAGNESIUM ALLOYS. Sandip K. Mitra and John E. Dorn (California. Univ., Berkeley. Lawrence Radiation Lab.). July 13, 1962. Contract W-7405-eng-48. 32p.

The factors involved in the low-temperature strain hardening of polycrystalline aggregates of Al and Mg–Al solid solutions were deduced from special test data. It was found that the dislocation densities, local interaction stresses, and long-range back stresses increased much more rapidly with strain in the polycrystals than in single crystals. The effects were further enhanced as a result of solid-solution alloying of Al with Mg. (auth)

23970 (WAL-TR-766.2/3-3) EVALUATION OF HIGH-STRENGTH LIGHTWEIGHT LAMINATED PRESSURE VESSELS OF LAP-JOINT CONSTRUCTION. Fourth Quarterly Progress Report, October 1 to December 31, 1962. G. Citrin (Republic Aviation Corp., Mineola, N. Y.). Jan. 16, 1963. Contract DA-30-069-ORD-3440. 22p. (AD-404182)

The production sheet metal material was delivered and evaluated against specification requirements. Rings were fabricated of the 0.021-inch thick mar-aging steel material for the first three pressure vessels. The first pressure vessel was assembled and tested successfully producing a burst strength 7.9 percent greater than that indicated by uniaxial tensile tests of the parent sheet metal. Failure occurred at 990 psi internal pressure. (auth)

23971 (WCAP-1868) COMPATIBILITY OF PbTe AND BiGeTe WITH POTENTIAL CLADDING AND INSULATING MATERIALS. R. C. Goodspeed (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Oct. 1961. Contract AT(30-3)-500. 35p.

The compatibility of lead telluride and/or bismuth germanium telluride with the following potential cladding materials was studied from 500 to 700°C: low carbon steel, AISI 304 and 430 stainless steel, aluminum, nickel, chromium, Zircaloy-2, vanadium, molybdenum, tungsten, niobium, Inconel, beryllium, and Armco iron. Also, the compatibility of lead telluride with the following potential insulating materials was studied from 550 to 750°C: AlSiMag 222, Supramica 620, Synthamica 202, and alumina. Lead telluride is compatible with Armco iron, beryllium, molybdenum, AISI 430 and 304 stainless steels, and low carbon steel at 650 and 700°C. It is similarly compatible with AlSiMag 222, Supramica 620, Synthamica 202, and alumina at 750°C. Bismuth germanium telluride is compatible with tungsten, aluminum, molybdenum, and vanadium at 600°C and with tungsten and aluminum at 650°C. (auth)

23972 (EURAEC-521) STEELS FOR REACTOR CASINGS—EXPERIMENTAL STUDY OF A THICK PLATE BRITTLE FRACTURE TEST METHOD. (France. Commissariat a l'Energie Atomique, Paris). Sept. 30, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 038-60-12-RDF. 35p. A translation.

A series of tests on working of thick (95 mm) steel plates using a 400-ton press is described. Brittle fracture as a function of temperature and stress was determined. Other measurements of temperature, stress, and strain were also made. Results confirmed the practicability of the experimental method for use on thicker (200 mm) plates using a planned 2000-ton press. (J.R.D.)

23973 (UCRL-Trans-930(L)) CERIUM–MAGNESIUM ALLOYS. Rudolf Vogel. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Z. Anorg. Chem., 91: 277-98(1915). 26p.

A study was made on the phase diagram of Ce–Mg alloys. A discussion is also included on the preparation and properties of the alloy. It was confirmed that the combination of the two metals takes place by mutual fusion with absorption of heat. Ce and Mg form four chemical compounds, Ce_4Mg, CeMg, $CeMg_3$, and $CeMg_9$ that exhibit pronounced particular features of loose (less compact) compounds. Their formation with mutual melting of the metals proceeds quite smoothly. (P.C.H.)

23974 DISLOCATION CONFIGURATIONS AND THE MICROSTRAIN OF POLYCRYSTALLINE BERYLLIUM. W. Bonfield and C. H. Li (Honeywell Research Center, Hopkins, Minn.). Acta Met., 11: 585-90(June 1963).

Optical and transmission electron microscopy studies showed that annealing hot pressed Be at elevated temperatures produces considerable changes in the density and distribution of dislocations within a grain without causing any change in grain size. Annealing also results in appreciable reductions in the microscopic yield stress, defined as the stress to cause a permanent strain of 2×10^{-6} in./in., and the rate of strain hardening in the microstrain region, which can be correlated with the observed changes in dislocation structure within a grain. It was found that the stress (σ) in the microstrain region, both for Be with a dense dislocation structure and Be with only a few isolated dislocations within a grain, is given by: $\sigma = C + B\epsilon^{1/2}$ where ϵ is the strain and C, B are some function of the dislocation density. Using this relation, values of the stress to move the first dislocations in Be are derived. A comparison is made of the observed microstrain characteristics of Be with previous results on other metals. (auth)

23975 ON THE CALCULATION OF MELTING TEMPERATURES FOR LOW-TEMPERATURE PHASES OF POLYMORPHIC METALS. A. J. Ardell (Stanford Univ., Calif.). Acta Met., 11: 591-4(June 1963).

Methods for the calculation of experimentally indeterminable melting points are discussed. It is shown that the melting temperatures can be significantly lower than normal melting points and must be used in such parameters as the reduced temperature, T/T_m, whenever the parameter pertains to the low-temperature phase of a polymorphic metal. A principle for the accurate location of such melting points is rigorously established from the fact that changes in thermodynamic state functions are independent of the path connecting the initial and final states. An empirical rule is proposed that enables rapid estima-

tion of the melting temperatures and in addition greatly facilitates the application of the rigorous procedure. (auth)

23976 THE SPECIFIC HEAT OF METALS BETWEEN 1200°K AND 2400°K. G. C. Lowenthal (Univ. of New South Wales, Sydney). Australian J. Phys., 16: 47-67(Mar. 1963).

Specific heat measurements were made on niobium (from 1471 to 2260°K), molybdenum (from 1288 to 2015°K), tantalum (from 1256 to 2300°K), and tungsten (from 1267 to 2410°K). The experiments were based on a theory first proposed by Corbino in 1911. It is demonstrated that methods based on this theory account for heat losses from the specimen under test to better than 0.5% even at 2400°K. The theory requires a knowledge of the temperature oscillations in thin a-c heated filaments and this amplitude is obtained from photoelectric measurements. The measured specific heat of each one of the four metals was found to rise more than linearly with the absolute temperature, while the specific heat at constant volume was found to increase approximately with the first power of the temperature. This behavior is briefly discussed. (auth)

23977 RELATION BETWEEN MICROSTRUCTURE AND THERMAL CONDUCTIVITY IN ALUMINUM–URANIUM ALLOYS. T. I. Jones, K. N. Street, J. A. Scoberg, and J. Baird (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. Met. Quart., 2: 53-72(Jan.-Mar. 1963).

Thermal conductivity measurements at 65°C were made on aluminum alloys containing up to 58 wt % uranium in the as-cast and heat-treated conditions. The measured conductivity varied from 0.541 cal sec^{-1} cm^{-2} $°C^{-1}$ cm for pure aluminum extruded rod, to 0.081 cal sec^{-1} cm^{-2} $°C^{-1}$ cm for a heat-treated alloy containing 58 wt % uranium. Changes in conductivities, produced by heat treatments, are related to corresponding changes in the microstructures of the alloys. The thermal conductivities of UAl_3 and UAl_4 were found to be 0.02 cal sec^{-1} cm^{-2} $°C^{-1}$ cm by extrapolation. (auth)

23978 INTERPRETATION OF THE HIGH-TEMPERATURE MAGNETIC SUSCEPTIBILITY OF URANIUM OXYSULFIDE UOS. Yves Ayant, Élie Belorizky, and Jean Rosset (Laboratoire de Physique Générale, Laboratoire d'Electrostatique et de Physique du Metal, Grenoble, France). Compt. Rend., 256: 2789-91(Mar. 25, 1963). (In French)

At high temperature, the experimental curve χT as a function of T of UOS shows the existence of two temperature regions for which there is a Curie law. This fact is interpreted by a blocking of the orbital magnetic moment of the ion by the crystalline field of quadratic symmetry. (tr-auth)

23979 EFFECT OF THE γ GRAIN SHAPE ON THE MORPHOLOGY OF URANIUM–MOLYBDENUM ALLOYS AFTER $\gamma \rightarrow \beta + \gamma \rightarrow \alpha + \gamma$ TRANSFORMATIONS. Jacques Decours, Jacqueline Lefranc, and Jeanne Lehmann (CEN, Saclay, France). Compt. Rend., 256: 2837-40(Mar. 25, 1963). (In French)

In low-concentration U–Mo alloys, the shape and form of the α pseudo-grain depend on the pre-existing microstructure in the γ region. This effect is shown by a modification of the growth mechanism of the β phase and by a modification of the $\gamma \rightarrow \beta$ transformation kinetics. (tr-auth)

23980 STUDY OF THE ROLE OF LATTICE FAULTS IN SUPERCONDUCTING ALUMINUM. Bernard Bonnin, Jean Geneste, and Bruce Bailey Goodman (Centre de Recherches sur les Très Basses Temperatures, Grenoble, France). Compt. Rend., 256: 3274-6(Apr. 8, 1963). (In French)

It is shown that in the irreversible magnetic behavior of superconducting Al alloys the sign of the surface energy plays an important role and that the role of dislocations is very weak. (tr-auth)

23981 RADIOGRAPHIC INSPECTION OF URANIUM METAL WITH LINEAR ELECTRON ACCELERATORS. Sanyo Hori and Tohru Kanemochi (Nagoya Industrial Research Inst., Japan). Genshiryoku Kogyo, 9: 57-61(Jan. 1963). (In Japanese)

X rays generated by a linear electron accelerator were used for the radiographic inspection of metallic U fuel elements. Details of experiments carried out with the linear accelerator at the Nagoya Industrial Research Institute are reported. U metal, with a purity of 99.9% and a density of 19.0 g/cm^3, was used for the preparation of wedges, containing deliberately introduced defects of various dimensions. These specimens were used to determine the lowest limit of detectability of defects by the technique. Au foils 3-mm thick were used as target material, exposing them to a 10-mm diameter, 40-μamp electron beam for periods ranging from 5 to 35 seconds. The x-ray dose was varied from 7 to 53 r, depending on the thickness of the specimens. Under these conditions, it was found that the smallest still recognizable defect has a diameter of 2 mm and a depth of 1 mm. (TTT)

23982 STABILIZED BARIUM TITANATE CERAMICS FOR CAPACITOR DIELECTRICS. J. B. MacChesney, P. K. Gallagher, and F. V. DiMarcello (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Am. Ceram. Soc., 46: 197-202(May 21, 1963).

The effects of additions of La_2O_3 and $La_2O_3-3TiO_2$ on the electronic properties of barium titanate were investigated. It was found that small additions of the components markedly increase the lifetime of the material subjected to d-c fields of 50 v per mil at 200°C. (auth)

23983 EFFECT OF Fe^{4+} IN THE SYSTEM $SrFeO_3-SrTiO_3$. Thomas R. Clevenger, Jr. (Massachusetts Inst. of Tech., Cambridge). J. Am. Ceram. Soc., 46: 207-10 (May 21, 1963).

Perovskites of the system $SrFeO_3-SrTiO_3$ were prepared, and measurements were made of their magnetic and electrical behavior. Chemical analysis showed that the percentage of Fe^{4+} varied from 72.5% for $SrFeO_{2.86}$ to about zero for $Sr(Fe_{0.1}Ti_{0.9})O_{2.95}$; the remainder of the iron was in the Fe^{3+} state and electrical balance was achieved by oxygen loss. $Sr(Fe_{1-x}Ti_x)O_3$ was antiferromagnetic between x = 0 and x = 0.9, with a Néel temperature below 60°K. A parasitic ferromagnetic component developed when the compounds were cooled in a magnetic field, the magnitude of the component being dependent on the cooling field. The conductivity of the perovskites ranged from 10^{-8} ohm^{-1} cm^{-1} for x = 1.0 to 10^{-2} for x = 0.0 and showed a marked change at x = 0.8. The break corresponded to a change in slope of the lattice parameter and the disappearance of Fe^{4+}. The Fe^{4+} content depended on the heat treatment and atmosphere during formation. (auth)

23984 THERMAL ANALYSIS OF LEAD BORATE GLASSES DURING CRYSTALLIZATION. C. G. Bergeron, C. K. Russell, and A. L. Friedberg (Univ. of Illinois, Urbana). J. Am. Ceram. Soc., 46: 246-7(May 21, 1963).

The crystallization behavior of 2 lead borate glasses was studied by the differential thermal analysis (DTA)

method, and the thermal effects were interpreted with the aid of supplementary information obtained from measurements of viscosity, thermal expansion, and microstructure. The glasses were found to nucleate readily at the air-glass interface; thus a powdered (−60 +100-mesh) sample of the glasses heated at 7.5°C per minute in the DTA apparatus developed a large quantity of crystals, and similar heating of a bulk sample resulted in very few crystals. A third glass (solder) showed no measurable degree of crystallization despite prolonged heat treatments of fine particles. Each glass exhibited an initial endotherm during heating and a corresponding exotherm during cooling. This was attributable primarily to coalescence of the glass particles. (P.C.H.)

23985 ELASTIC CONSTANTS OF THALLIUM SINGLE CRYSTALS IN THE TEMPERATURE RANGE 4.2-300°K. R. W. Ferris, M. L. Shepard, and J. F. Smith (Ames Lab., Ames, Iowa). J. Appl. Phys., 34: 768-70(Apr. 1963). (IS-554)

The five independent elastic constants of single crystals of the hexagonal allotrope of thallium were determined by the ultrasonic pulse-echo technique over the temperature range 4.2 to 300°K. The values at 300°K in units of 10^{11} dyn/cm^2 are $C_{11} = 4.080$, $C_{33} = 5.280$, $C_{44} = 0.726$, $C_{12} = 3.54$, and $C_{13} = 2.9$. The compressibility derived from these elastic constants is in good agreement with the compressibility obtained by Bridgman from hydrostatic measurements on polycrystalline samples. (auth)

23986 THE VISCOSITY OF LIQUID PLUTONIUM, PREDICTED FROM A GENERAL RELATIONSHIP BETWEEN THE ACTIVATION ENERGY AND MELTING POINTS OF METALS, AND THE EXPERIMENTAL DATA. A. V. Grosse (Temple Univ., Philadelphia). J. Inorg. Nucl. Chem., 25: 137-8(Mar. 1963).

The experimental viscosity values of liquid plutonium, determined in the range of 648 to 950°C, are compared with the values predicted from an empirical relationship between the melting point of a metal and the activation energy of viscous flow. The agreement is very satisfactory. The predicted viscosity line for La is also shown. (D.L.C.)

23987 X-RAY STUDY AND THERMOELECTRIC PROPERTIES OF THE $NbSi_xGe_{2-x}$ AND THE $TaSi_xGe_{2-x}$ SYSTEMS. L. H. Brixner (E. I. du Pont de Nemours and Co., Wilmington, Del.). J. Inorg. Nucl. Chem., 25: 257-60 (Apr. 1963).

The AB_2-type silicides and germanides of niobium and tantalum as well as numerous solid solutions were prepared and were structurally characterized. All compositions crystallize in the C40 type, and complete solid solubility between the corresponding silicides and germanides was experienced. The thermoelectric parameters were determined at room temperature for all compositions and also at higher temperatures for the specific composition NbSiGe. (auth)

23988 THE EMPIRICAL RELATIONSHIP BETWEEN THE ACTIVATION OF ENERGY VISCOSITY OF LIQUID METALS AND THEIR MELTING POINTS. A. V. Grosse (Temple Univ., Philadelphia). J. Inorg. Nucl. Chem., 25: 317-18(Apr. 1963).

A new empirical relation is developed on the basis of Cavalier's new data on high-melting metals. The relation, a straight line on a log-log graph, is $H_\eta = 0.431\ T_M^{1.348}$ over the T_M range of 200 to 2000°K. Thus, the viscosity of any metal at any temperature can be calculated from this relation and Andrade's equation $\eta = a \exp(H_\eta/RT)$. (D.L.C.)

23989 THE EFFECT OF NITRIDING ON THE ELEVATED TEMPERATURE TENSILE PROPERTIES OF SOME MOLYBDENUM-BASE ALLOYS. A. K. Mukherjee and J. W. Martin (Oxford Univ.). J. Less-Common Metals, 5: 117-27(Apr. 1963). (In English)

The elevated-temperature tensile properties of Mo–0.49% Ti, Mo–0.98% Ti, and Mo–1.5% Zr specimens, in both the dispersion-hardened and the recrystallized conditions, were investigated between room temperature and 900°C using two strain rates. The effect of increase in temperature and in strain rate on ultimate tensile stress and ductility were studied and metallographic and fractographic observations were made on the tested specimens. The results are discussed in the light of current theories of elevated temperature deformation and intergranular failure. (auth)

23990 SOME OBSERVATIONS ON ALUMINUM–THULIUM ALLOYS. T. I. Jones, L. R. Norlock, and R. R. Boucher (Atomic Energy of Canada, Ltd., Chalk River, Ont.). J. Less-Common Metals, 5: 128-33(Apr. 1963). (In English)

Aluminum alloys containing 4 to 40 wt % thulium were prepared in sheet form down to 0.004 in. thick. The alloys were found to be two-phase: (1) α-aluminum which contained less than 0.1 wt % thulium in solution at 645°C and (2) an intermetallic compound, $TmAl_3$, possessing a simple cubic structure of the $AuCu_3$ type with $a_0 = 4.200$ Å. The two phases form a eutectic at 10 ± 1 wt % thulium which melts at 645 ± 3°C. A second intermetallic compound, with a face-centered cubic structure of the $MgCu_2$ type and $a_0 = 7.770$ Å, was identified in an alloy containing originally 68 wt % of thulium which was cooled relatively rapidly. (auth)

23991 THE MOLYBDENUM–ZIRCONIUM–CARBON SYSTEM. T. C. Wallace, C. P. Gutierrez, and P. L. Stone (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 67: 796-801(Apr. 1963). (LADC-5468)

The approximate phase boundaries of the solid portion of the 2100°C isothermal section of the Mo–Zr–C system were determined by chemical and x-ray techniques. Two of the more interesting features are: an extensive horn shaped solid solution region formed between ZrC and Mo_3C_2 that extends from the Zr–C boundary to $Mo_{0.58}Zr_{0.02}C_{0.40}$, and the highest carbide of the Mo–C system, Mo_3C_2 ($a_0 = 3.010 \pm 0.002$, $c_0 = 14.62 \pm 0.01$ A) lies at 38 at.% C. ΔF_f^0 of $MoC_{0.61}$ (~1/3 Mo_3C_2) is estimated to be -2.6 ± 1.5 kcal/mole. In addition, the phases in equilibrium in the low-carbon portion of the 1500°C isothermal section were established, and melting temperatures were determined along the Mo–C boundary and in the high-carbon (C > 50 at.%) portion of the ternary. (auth)

23992 THE EFFECT OF ELECTRON-ELECTRON INTERACTION ON THE NUCLEAR SPIN RELAXATION IN METALS. Tôru Moriya (Tokyo Univ.). J. Phys. Soc. Japan, 18: 516-20(Apr. 1963).

The rate of the nuclear spin-lattice relaxation due to the hyperfine interaction is shown to be enhanced by a repulsive electron-electron interaction. The relaxation time is expressed in terms of the wavelength and frequency dependent magnetic susceptibilities of the conduction electrons. The magnetic susceptibilities are calculated taking account of the electron-electron interaction of the δ-function type with a random phase approximation. The Korringa relation between the frequency shift and the relaxation time is shown to be altered by the electron-electron interaction. The theory applies also to the elec-

tron spin relaxation of localized magnetic atoms in certain alloys. (auth)

23993 RADIATION AND ACOUSTIC EXCITATION OF ANOMALOUS LAYERS ON PEROVSKITE FERROELECTRICS. I. Lefkowitz (Cambridge Univ., Eng.). Nature, 198: 657-9(May 18, 1963).

Experiments were carried out on the x-ray excitation of the surfaces of $BaTiO_3$ and $PbTiO_3-PbZrO_3$. Representative photographs of the output from one sample are presented. The results support the existence of a space-charge layer on the surface with different net polarities on different parts of the same sample. An equivalent circuit is described, and the possible effects of these layers on the use of ferroelectrics are discussed briefly. (D.L.C.)

23994 PHASE CHANGE AND HEAT TREATMENT OF U-Fe ALLOYS. [PART] II. Kō Soeno (Hitachi Ltd., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 280-6(Apr. 1963). (In Japanese).

The kinetics of isothermal transformation were studied with uranium alloys varying in iron content 0.5 to 1.0 at. %. Two modes of β-to-α transformation, nucleation-and-growth and martensitic transformations, were observed and M_s temperature was determined as a function of iron content. The M_s temperature increases with decreasing iron content, so the martensitic transformation, which produces coarse α-uranium grains, prevails in such alloys of lower content of iron. Nucleation and growth mode is found to be applicable to grain refinement. And suitable grain refinement is generally attained by isothermal transformation in the temperature region from 450°C to M_s temperature. (auth)

23995 STUDIES ON Zr-Cu-Mo BASE ALLOY. I. STUDY ON FUNDAMENTAL PROPERTIES OF Zr-Cu-Mo ALLOYS. Shigeo Aoki (Furukawa Electric Co., Ltd., Japan), Isao Tarora, Ryukichi Hashiguchi, and Yoshitsugu Mishima. Nippon Genshiryoku Gakkaishi, 5: 305-10(Apr. 1963). (In Japanese)

The fundamental properties, such as the physical and mechanical properties, the heat-treatment characteristics, and corrosion resistance in high temperature and pressurized CO_2 gas, of various Zr-Cu-Mo alloys which are used for the construction material of the fuel element for the gas-cooled power reactor, were investigated. The contents of Cu and Mo as the alloying elements are in the range of 0.5 to 1.5%. Results obtained are summarized as follows: (1) The transformation temperature from γ to β is about 750°C. (2) Alloys have good workability and the mechanical properties are nearly the same as these for Zircaloy-2. (3) Improvements of the mechanical properties are expected by heat treatment. (4) These alloys of Zr-0.5% Cu-1.0% Mo, Zr-0.5% Cu-1.5% Mo and Zr-1.5% Cu-1.5% Mo have good corrosion resistance in high temperature and pressurized CO_2 gas. (auth)

23996 ON THE ELECTRON-PHONON INTERACTION IN NORMAL METALS. [PART] I. Sadao Nakajima and Mitsuo Watabe (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 29: 341-50(Mar. 1963). (In English)

The effect of the electron-phonon interaction on the density of one-electron states in a metal is discussed in consistence with electric conductivity. By the use of the same hamiltonian and the same approximation as in Bardeen's theory of resistivity, one obtains the electron mass shift $\Delta m/m = 0.32$ for sodium in good agreement with the experimental data on specific heat. It is shown that the bare electron mass appears in static conductivity and anomalous skin effect. It is suggested that the electron mass is frequency-dependent in the infrared region. (auth)

23997 DIFFUSION AND MOBILITY OF Sb^{124} IN NICKEL. P. P. Kuz'menko and G. P. Grinevich (Shevchenko State Univ., Kiev). Soviet Phys.-Solid State (English Transl.), 4: 2390-2(May 1963).

The results of a study of the diffusion and mobility of Sb^{124} in nickel are reported. A formula for the temperature dependence of the coefficient of diffusion in nickel was given. In all tests on the mobility in nickel it was found that the antimony moved toward the cathode during passage of a direct current. Analysis of the temperature dependence of the force causing this motion led to the conclusion that the motion is dominated by the hole-wind force appearing as a result of the scattering of holes on diffusing antimony ions. (auth)

23998 NONLINEAR PROPERTIES AND PHASE TRANSITIONS OF STRONTIUM-BISMUTH TITANATES. A. N. Gubkin, A. M. Kashtanova, E. V. Potapov, and A. V. Solodukhin (Lebedev Inst. of Physics, Moscow). Soviet Phys.-Solid State (English Transl.), 4: 2411-16(May 1963).

Nonlinear properties of dielectrics of the system $SrTiO_3-Bi_2O_3 \cdot 3TiO_2$—the dependence of ϵ, tan δ, and the polarization on electric field intensity—are investigated over a wide temperature range. Data are given characterizing the temperature dependence of the coefficient of linear expansion. The physical nature of phase transitions is discussed. (auth)

23999 REFRACTORY COMPOUNDS, THEIR PROPERTIES, PRODUCTION, AND PART IN MODERN ENGINEERING. G. V. Samsonov. Tr. Seminara po Zharostoikim Materialam, Akad. Nauk Ukr. SSR, Inst. Metallokeram. i Spets, Splavov, Kiev, 1960, No. 6, 5-29(1961).

The most promising materials are hard and refractory metal-like compounds of rare and rare-earth metals (Ti, Zr, Hf, V, Nb, Ta, Mo, W, La, Ce, Y) with B and C, Si, N, S (borides, carbides, silicides, nitrides, sulfides). The materials offer high hardness, wear resistance, strength and refractoriness, and a series of specific physical properties. The basic physical and mechanical properties of the technically most important refractory compounds are given. A detailed description is given of the fields where the materials are to be used according to their basic properties (ultra-heat-resistant materials, chemically stable alloys, heat and scale resistant alloys, hard, and electric-and-radio-engineering materials). (Referativnyy zhurnal, Metallurgiya, No. 8, 1962)

24000 THE AGGLOMERATION OF HYDROGEN IN ALUMINUM. C. E. Ells and W. Evans (Atomic Energy of Canada Ltd., Chalk River, Ont.). Trans. AIME, 227: 438-46(Apr. 1963).

The agglomeration of hydrogen in pure Al and Al-Mg alloys was studied through use of H introduced into the metal by cyclotron proton irradiation. Both the growth and dispersal of the agglomerates were followed by metallographic techniques. During the cyclotron irradiation, agglomeration occurs at temperatures $\leq$ 100°C for H concentrations as low as 1 ppm. On heating at elevated temperatures, 300 to 600°C, intragranular agglomerates first coarsen and then disperse. The agglomerates formed at grain boundaries are much larger than the intragranular agglomerates; with hydrogen concentrations >10 ppm, heating for 1 hr at 500°C results in extensive grain-boundary cracking. The H agglomerates were shown to inhibit grain growth, but no inhibition of recrystallization was observed. The ability of H to enter Al at a free surface, combined with its high-diffusion rate at elevated temperatures, accounts both for growth and dispersal of the agglomerates. Irradiations at elevated temperatures

give results consistent with the explanation proposed for agglomerate behavior on post-irradiation heating. (auth)

24001 HIGH-TEMPERATURE SOLID-SOLUTION-STRENGTHENED COLUMBIUM ALLOYS. E. S. Bartlett (Battelle Memorial Inst., Columbus, Ohio), D. N. Williams, H. R. Ogden, R. I. Jaffee, and E. F. Bradley. Trans. AIME, 227: 459-67(Apr. 1963).

The mechanical properties of solid-solution-strengthened Nb alloys were assessed as a function of alloying additions. Studies included the effects of W, Ta, Mo, and V. Elevated temperature fabrication was required at alloying levels above about 15% W or 10% Mo. W, Mo, and V additions increase tensile strength at room temperature and 2200°F, but Ta additions exert little strengthening. Similarly, W, Mo, and probably V additions increase the ductile-to-brittle transition temperature, and Ta additions decrease the parameter. The 2200°F stress-rupture strength is increased by W and Mo additions; with 20 to 25 at. % additions, 100-hr rupture strengths of 30000 psi are obtainable. Small V additions exhibit mild stress-rupture strengthening, and Ta additions are innocuous. At 2500°F, W additions retain stress-rupture strengthening capability, but Mo additions are much less effective. Ta additions augment the stress-rupture strengthening of W plus Mo additions at 2500°F. (auth)

24002 EFFECT OF THE SECOND PHASE OF THE "WORK SOFTENING" PHENOMENON OF ALUMINUM ALLOYS. Shiro Terai and Yoshio Baba (Sumitomo Light Metal Industries, Ltd., Japan) Trans. Japan Inst. Metals, 3: 237-43(Oct. 1962). (In English)

Experiments were carried out to study the effect of the second phase of metallic compounds on the "Work Softening" phenomenon in Al–Fe, Al–Si, Al–Mn, and Al–Li alloys. When particles of metallic compounds were dissolved by quenching after solution treatment so that the ingot was in the state of super-saturated solid solution or eutectics, the "Work Softening" phenomenon was not observed in the sheet obtained from this ingot. On the other hand, the "Work Softening" phenomenon was observed in the sheet produced by a process of preheating the ingot followed by an intermediate heat treatment to precipitate a large amount of metallic compounds, when light rolled after final annealing at the temperature of the softening stage. The finer the precipitated particles were, the more distinctively the "Work Softening" phenomenon was observed with no connection with natural or artificial aging after light rolling. Regarding the process of "Work Softening" phenomenon, it cannot be explained by the Cottrell mechanism. Therefore a more thorough investigation in the light of the sub-grain formation by dislocation rearrangement may be required. (auth)

24003 REACTION OF HYDROGEN WITH SOLUTES IN METALS. Ralph Wendell Curtis. Thesis, Ames, Iowa, Iowa State Univ. of Science and Tech., 1962. 74p.

The equilibrium hydrogen pressure over a system consisting of Ca and CaH_2 was measured in the temperature range 600-900°C. A change in slope at 780°C is to be expected on the basis of a solid state transformation existing in CaH_2. The H dissociation pressures for the temperature range 600-780°C were combined with known thermodynamic data for Ca along with known data on the Ca-H system to give the following thermodynamic relations: $\Delta F^\circ_{CaH_2} = -24{,}278 + 31.52T$ (440-780°C) and $\Delta F^\circ_{CaH_2} = -41{,}410 + 24.78T + 1.93 \log T$ (25-440°C). The equilibrium H_2 pressure was also measured over the system consisting of CaH_2, $CaMg_2$, and a Mg-rich Ca-Mg solution. A change in slope at 517°C is to be expected on the basis of a eutectic horizontal at this temperature. The data in the temperature range 450-517°C were combined with the thermodynamic properties for CaH_2 to give the following relations: $\Delta F^\circ_{CaMg_2} = -10{,}624 + 4.28T$ (440-517°C) and $\Delta F^\circ_{CaMg_2} = -9{,}735 - 2.46T + 1.93T \log T$ (25-440°C). It was found that the intermetallic phases $CaPb_3$, $CaAg_4$, $CaAg_3$, $ThCu_6$, and Th_2Ni_{17} did not absorb H at pressures up to one atmosphere and temperatures up to 700°C. (M.P.G.)

Radiation Effects

Refer also to abstracts 23918 and 24613.

24004 (BMI-1627) EFFECT OF HIGH BORON BURNUPS ON B_4C AND ZrB_2 DISPERSIONS IN Al_2O_3 AND ZIRCALOY-2. Richard J. Burian, Earle O. Fromm, and John E. Gates (Battelle Memorial Inst., Columbus, Ohio). Apr. 24, 1963. Contract W-7405-eng-92. 40p.

Various types of dispersions of B_4C in Al_2O_3 and Zircaloy-2 and ZrB_2 in Zircaloy-2 were irradiated at temperatures of about 400 to 500°F to B^{10} burnups of 81 to 96%. The variables investigated included B loading in the range of 2.7 to 4.8 vol %, particle size, matrix density, and fabrication methods. The irradiated Al_2O_3-matrix pellets increased in diameter from 1.5 to 3.3% and released from 1.3 to 2.6% of the He formed. The matrix contained a network of cracks connecting all B_4C particles. During a corrosion test of three pellets in 600°F reactor-grade water the pellets disintegrated. Variations in the parameters investigated did not affect the radiation stability of these dispersions. The irradiated Zircaloy-2-matrix pellets were unchanged except that boride particles at the pellet surfaces were swollen. Pellets containing B_4C exhibited little change in diameter while those containing ZrB_2 exhibited up to 0.3% increase in diameter. Helium release from both types of Zircaloy-2-matrix pellets could be accounted for by recoil from boride particles in the pellet surfaces. The pellets exhibited good He retention during postirradiation heating up to 1000°F and excellent resistance to corrosion by 600°F reactor-grade water. The Zircaloy matrix around each B_4C particle exhibited an area of visible damage, presumably from recoil atoms. (auth)

24005 (BMI-1628) INITIAL IRRADIATION EVALUATION OF EXPERIMENTAL PYROLYTIC-CARBON-COATED UC_2 AND UO_2. Richard J. Burian, Neil E. Miller, Robert L. Ritzman, and Charles W. Townley (Battelle Memorial Inst., Columbus, Ohio). Apr. 25, 1963. Contract W-7405-eng-92. 22p.

Static and sweep irradiation capsules were used to evaluate the in-pile performance of experimental pyrolytic-carbon-coated UC_2 and UO_2 particles at temperatures ranging from 100 to 1070°C. Failure of the coatings occurred in all cases where average coating thicknesses were less than about 70 μ. At 100°C the failure was very rapid, occurring after about 6 hr of irradiation in the case of UC_2 particles with a 57-μ columnar pyrolytic-carbon coating. At elevated temperatures failure did not begin until after about 5 to 10 days of irradiation and appeared to be associated with temperature changes caused by reactor shutdowns and startups. Coating failure at low temperature did not occur in the case of particles with thick (greater than about 110 μ) columnar or laminar pyrolytic-carbon coatings and with thick (greater than about 90 μ) coatings containing layers of porous pyrolytic carbon. (auth)

24006 (BNL-6198) RADIATION DAMAGE IN GRAPHITE. II. CONSECUTIVE AND STEADY STATE REACTIONS OF INTERSTITIAL COMPLEXES. Donald G. Schweitzer (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 29p.

Periodically irradiated and annealed graphites show property changes that are markedly different from the changes after the first irradiation and anneal. Evidence is presented indicating the existence of consecutive reactions between interstitial complexes that lead to steady state concentrations of the intermediate species in a chain. The steady state concentrations result in dimensional recoveries and stored energy releases that do not increase with irradiation as they do in continuously irradiated graphites. Interstitial complexes, formed by a thermal anneal, interact through an integral chain via mobile single interstitials. Kinetic equations of chains reacting at one or both ends are described. The calculations for chains reacting at both ends show that large complexes can decompose to form smaller ones. Experimental evidence supporting the calculations shows that periodic removal of the smaller complexes by low temperature anneals results in the net removal of large amounts of damage associated with the layer interstitials. (auth)

24007 (BNL-6313) RADIATION DAMAGE IN GRAPHITE. III. KINETIC REACTIONS OF INTERSTITIAL COMPLEXES: AN EXPERIMENTAL STUDY. Donald G. Schweitzer and Robert M. Singer (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 27p.

Dimensional changes resulting from reirradiations and anneals in repeatedly irradiated graphites show that the rate of formation of carbon atoms in interstitial complexes is proportional to the irradiation interval when reactions occur at both ends of the chain. When reaction occurs at only one end of the chain the overall rate of production of interstitial carbon atoms is initially dependent on the exposure and then becomes constant. The rate of decomposition of the complexes appears to depend only on the cross sections (number of carbon atoms) of the complexes. After removal of some of the complexes (by a thermal anneal), initial reirradiations decompose remaining complexes and form the complexes that were removed by the anneal. When the complexes that were removed by the anneal reach their steady state concentrations, further irradiation re-forms the complexes that decomposed. Prolonged reirradiations finally result in the successive formation of new complexes that anneal at high temperatures. (P.C.H.)

24008 (GA-3448) AUTOMATIC TEMPERATURE CONTROL OF IRRADIATION CAPSULES BY A VARIABLE BINARY GAS MIXTURE. R. C. Drescher and Dale E. Johnson (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Sept. 12, 1962. Contract AT(04-3)-187. 12p.

Temperature control was achieved by varying the gas mixture, and therefore the thermal conductivity, in a gas annulus surrounding the irradiation capsule. Control systems were used for over one year and maintained capsule temperature to ±10°F. The system may be used equally satisfactorily with either fueled or nonfueled capsules. The reliability of the system was extremely high, and all maintenance was limited to the readily accessible instrumentation. (auth)

24009 (GEMP-22A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 22, PART A. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 30, 1963. Contract AT(40-1)-2847. 23p.

Studies were made of planar type of preferred orientation, microscopic examination of helium bubbles was carried out, and measurements were made of the radiation expansion, thermal expansion, and strength of irradiated BeO specimens of the grain size–density series. In randomly oriented material, expansion of BeO specimens with grain sizes of 5-, 10-, 20-, and 50-microns in 100°C irradiations followed the trend of smaller expansion as grain size decreased. In the UOX-MgO composition, the expansion follows a trend consistent with the extent of preferred orientation. Specimens containing 75% or more preferred orientation showed a remarkable reduction of expansion at 100°C but the reduction did not persist at irradiation temperatures of 300 to 600°C. The thermal expansion behavior of BeO did not appear to be changed in specimens irradiated at elevated temperatures or in thermally annealed specimens. (auth)

24010 (IFA/IS/21) EFFECTS OF NUCLEAR RADIATION ON ELECTRICAL CONDUCTIVITY OF CHROMIA. M. Nachman and L. Cojocaru (Academia R. P. R. Institutal de Fizică Atomică, Bucharest). 1962. 11p.

Nuclear radiations were found to cause two kind of effects in the electric conductivity of Cr_2O_3. Ionization effects, which lead to a rise in the conductivity due to the generation of charge carriers in excess, are not permanent, they disappear after cessation of radiation. Displacement effects, which lead to a decrease of the conductivity due to formation of trapping centers in the Cr_2O_3 lattice, are permanent at room temperature but can be annealed at higher temperatures. Below annealing temperature the temperature dependence of the electric conductivity of Cr_2O_3 is not affected by irradiation. (P.C.H.)

24011 (NLCO-876) IRRADIATION GROWTH IN NATURAL URANIUM FUELS. Peter R. Morris (National Lead Co. of Ohio, Cincinnati). [Apr. 1963]. Contract [AT(30-1)-1156]. 10p.

A review is given on the crystal structure and irradiation growth and its mechanism of alpha uranium. It was concluded that it is reasonable to assume that the mechanical properties of alpha uranium are not appreciably altered during irradiation. (P.C.H.)

24012 (ORNL-3443) ANNEALING OF GAMMA RAY INDUCED CHANGES IN ANTIMONY DOPED GERMANIUM. Jay Cee Pigg (Oak Ridge National Lab., Tenn.). May 28, 1963. Contract W-7404-eng-26. 110p.

An investigation of the annealing of the radioinduced carrier concentration change in Sb-doped Ge in the range 370 to 455°K was made. The irradiations were conducted at liquid nitrogen temperature using Co^{60} gamma irradiation. A model that explains the observed behavior is presented. On the basis of the model, the observed annealing consists of vacancy diffusion simultaneously to impurity sites and annihilation centers. Analysis of the activation energy for the annealing process yields values of 0.8 to 1.4 ev in agreement with the range of energies that were attributed to vacancy motion but that cannot be resolved into unique components. The complex activation energy is explained by the model in terms of the impurity concentration. It was observed that the change in carrier concentration saturates before complete annealing is achieved. The saturation, which is stable for further annealing at higher temperatures, is also explained in terms of the model. The vacancies are considered to diffuse to annihilation centers, such as dislocation lines, and to the site adjacent to an Sb atom. Those that go to an Sb are trapped. The Sb-vacancy complex can break up to supply a vacancy back to the sys-

tem or can trap an additional vacancy producing an Sb-divacancy complex. The Sb-divacancy complex is stable for the temperature range considered. The Sb-vacancy reaction comes into equilibrium very quickly compared to the annihilation process. (auth)

24013 (TID-18630) RADIATION EFFECTS ON NON-METALLICS. [G. W. Arnold] (Sandia Corp., Albuquerque, N. Mex.). Mar. 1963. Contract [AT(29-1)-789]. 63p. (SCDC-2907)

The effects of radiation on non-metallics is reviewed briefly. It is shown that the effects result from interplay between electrons and holes, interstitial atoms and their vacancies, and the imperfections originally present in the material. Types of radiation sources are also reviewed briefly. (P.C.H)

24014 (EURAEC-530) STEELS FOR REACTOR CASINGS—IRRADIATION OF STEEL SPECIMENS IN EL 3 AT DIFFERENT TEMPERATURES AND TESTS AFTER IRRADIATION (PARTIAL RESULTS). (France. Commissariat a l'Energie Atomique, Paris). Dec. 31, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 039-61-12-RDF. 50p. A translation.

Activities in a program concerned with irradiation temperature effects on the tensile strength of steels containing 0.03 to 0.5% C are reported. Other steels tested include a Mn–Mo weldable alloy and high-strength weldable Ni–Cr steels. The irradiations reported were carried out in the EL-3 reactor at 60 to 400°C to average doses of 10^{19} nvt. Preliminary post-irradiation test results indicate that a maximum hardening occurring between 100 and 200°C is associated with the C content and yield strength of the materials. Further analysis of results is in progress. (J.R.D.)

24015 (EURAEC-549) BASIC STUDY OF THE IN-PILE BEHAVIOR OF PLUTONIFEROUS MATERIALS. Quarterly Report No. 5, October 1–December 31, 1962. (Société Belge pour l'Industrie Nucléaire, Brussels). Jan. 1963. Work Performed under United States–Euratom Joint Research and Development Program. 26p. A translation.

Data and information obtained in investigations on the thermal behavior of uranium oxide fuel are presented. Investigations of the Pu distribution in specimens being prepared for irradiation are also reported along with results of studies on the thermal properties of N_2-containing UO_2. Preparations for post-irradiation tests are described. (J.R.D.)

24016 RADIOINDUCED STRESS IN GRAPHITE AND CARBON BLOCKS. O. Machnig and P. Handge (Brown Boveri Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomkernergie, 8: 125-31(Apr. 1963). (In German)

The core of a graphite-moderated reactor consists essentially of graphite and sometimes of carbon blocks. For reasons of design, a graphite arrangement of structural components with the largest possible geometrical dimensions is needed. In designing the graphite arrangement, the radioinduced tensions should be taken into consideration in addition to the conventional static principles. The radiation effects on graphite and carbon blocks produce relatively great dimensional changes, the quantity of which depends to a large extent on the neutron dose. Since the dose in the individual structural components generally depends on the position, unequal extensions, and/or contractions are caused within the structural components, and, thus, tensions induced. Proof that radioinduced tensions may amount to considerable quantities in large structural parts and, thus, become the determining factor in the arrangement of the graphite part of the reactor core is presented. (auth)

24017 THE EFFECT OF ELECTRON IRRADIATION ON SOME ALKALI HALIDE SINGLE CRYSTALS. Z. Morlin and J. Tremmel (Chemical Structures Research Lab., Hungarian Academy of Sciences, Budapest). Czech. J. Phys., 13: 216-18(1963). (In English)

The investigated alkali halides NaCl, KCl, RbCl, and CsCl decompose under electron irradiation into alkali metal colloids and chlorine gas. This decomposition is a special case of radiation damage effects, which strongly influence the crystalline structure and the physical properties of the crystals under investigation. The decomposition process consists of the breaking up of the single crystalline material into polycrystalline aggregates; at the same time cavities, or larger aggregates of vacancies are produced, which, together with the boundaries of the polycrystalline aggregates, serve as the nuclei of growing dark platelets, which appear to be precipitated alkali metal crystals. (auth)

24018 THE EFFECT OF IRRADIATING INDIUM WITH THERMAL NEUTRONS ON ITS MOLECULAR VAPOR COMPOSITION. E. G. Shvidkovskii, G. M. Martynkevich, and G. V. Malyarova (Moscow State Univ. and Central Aerological Observatory, USSR). Dokl. Akad. Nauk SSSR, 149: 816-17(Apr. 1, 1963). (In Russian)

Three indium foils 40 to 50μ thick were given a total neutron dose of 10^{12} to 10^{14} n/cm^2. The foils were fused and degassed in a fused-quartz crucible in a mass spectrometer. The ratio of ion current due to the dimer I_2 to the ion current due to the monomer I_1 ($i = I_2/I_1$) was determined as a function of temperature from 773 to 1373°K (melting point of indium is 429.4°K), and these values were compared with values obtained on unirradiated foils of indium. It was found that i increases with temperature in both cases, but the value of i for the irradiated samples is a factor of 15 to 20 greater than that of the unirradiated samples ($\sim 10^{-2}$ compared to 3×10^{-4} for the unirradiated samples). This effect can be detected even after the lapse of one year after the irradiation of the sample. On heating the irradiated sample to a temperature of 1423 to 1473°K for a short time, the sample lost its ability to form the dimer, and could not be distinguished from an unirradiated sample. (TTT)

24019 GAMMA RADIATION EFFECTS ON DIELECTRIC PROPERTIES OF INSULATION MATERIALS. IV. ED-6 EPOXIDE COMPOUND. G. I. Potakhova, B. I. Vorozhtsov, and I. S. Filatov (Tomsk State Univ., Siberian SSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 155-9 (1963). (In Russian)

Effects of γ radiation on the dielectric properties (tg δ, ϵ, E_{pr}, and ρ_v) of ED-6 epoxy compounds were studied under various conditions. Exposure to 670 r/min with low electric field frequency produced an angle of loss in quartz bearing ED-6 resin that increased and decreased with electric field frequencies and temperature. The tg δ properties were determined by the radiation dose. With given integral doses the dielectric penetrability and electric resistance were not disturbed. An increase of tg δ properties in exposed materials containing quartz indicated a high radiosensitivity of quartz admixtures. (R.V.J.)

24020 EFFECTS OF γ RADIATION ON THE ELECTRIC CONDUCTIVITY OF ALKALI SILICATE GLASS IN STRONG ELECTRIC FIELDS. L. M. Belyavskaya. Izv.

Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 164-70(1963). (In Russian)

Radiation effects on electric conductivity of technical glass and sodium silicate glass containing 20, 22, and 26% Na_2O were studied at $h\nu$ = 1.25 Mev. (R.V.J.)

24021 DEFECT STRUCTURE AND DENSITY DECREASE IN NEUTRON-IRRADIATED QUARTZ. Sigmund Weissmann and Koichi Nakajima (Rutgers Univ., New Brunswick, N. J.). J. Appl. Phys., 34: 611-18(Mar. 1963). (NYO-10445)

Lattice defects in quartz induced by fast neutron irradiation were studied by combined methods of x-ray diffraction and transmission electron microscopy. The developed defect structure is characterized by clusters of interstitials enriched in ruptured silicon atoms. The size and density of the defect clusters increase with increasing dose until mutual interaction occurs, resulting in the formation of a stable, hexagonal-like structure resistant to prolonged annealing at 500°C. In thin crystals the size and volume fraction of the defect clusters are dependent on crystal orientation, being related to the open screw channels of the quartz structure. A relationship was established between the total volume fraction of defect clusters and fractional decrease in density induced by neutron irradiation, accounting satisfactorily for the hydrostatic density measurements reported in the literature. (auth)

24022 ELECTRON MICROSCOPIC STUDY OF FISSION FRAGMENT DAMAGE IN MOLYBDENITE CRYSTALS. Kazuhiko Izui and F. Eiichi Fujita (Japan Atomic Energy Research Inst., Tokyo). J. Phys. Soc. Japan, 18: 467-76(Apr. 1963).

Electron microscopic observation was carried out on fission fragment-irradiated molybdenite crystals. Tracks of fission fragments in the crystals were observed as continuous straight lines and linear arrays of spots and rings. From the change of their image contrasts in the tilting experiment and the disturbances in the moiré patterns around the tracks, it was found that the track consists of a narrow non-uniform cylindrical region associated by some dotted blister-like swellings. The origin of such blister-like regions may be interpreted by either of the non-uniform solidification in the temperature spiked region along the path of fission fragment or more probably the displacement spike effect by the knock-ons with energies higher than about 500 ev. Bent and forked tracks resulting from nuclear collisions between fission fragments passing through the lattice and atoms on the lattice sites were observed and analysed. Interaction between dislocation lines and the tracks was observed, indicating that strong stress fields around the tracks cause the slip motion of the dislocations by elastic interaction. (auth)

24023 STUDY OF THE MAGNETIC RESONANCE OF IRRADIATED SEIGNETTE SALTS. G. Asch, M. Fontanel, and G. Mesnard. J. Phys. Radium, 23: 1006-8(Dec. 1962). (In French)

A study was made on γ- and x-irradiated polycrystalline salts to clarify the role of the water of hydration in the mechanism of ferroelectricity. The effect of the degree of hydration on the shape of the magnetic resonance spectrum was determined, and the spectra of various anhydride or hydrated tartrates were compared. The results show that as the degree of dehydration increases, the intensity of the third group is attenuated, the second group tends to coincide with group 1, and the length of the latter augments. The study of the tartrates shows that the hydrated salts have spectra similar to that of Seignette salt. The spectrum of anhydric tartaric acid is constituted by the first and second groups only. The spectrum of anhydrous ammonium tartrate is similar to the spectrum of anhydrous Seignette salt. The spectrum of potassium acid tartrate differs from that of any of the other tartrates. These results indicate that the water of hydration plays a basic role in the appearance of the third group. (J.S.R.)

24024 HARDENING OF COPPER SINGLE CRYSTALS BY NEUTRON IRRADIATION AT LOW TEMPERATURES. J. Diehl (Max-Planck-Institut für Metallforschung, Stuttgart) Chr. Leitz, and W. Schilling. Phys. Letters, 4: 236-8(Apr. 15, 1963). (In English)

Copper single crystals of identical orientation were irradiated at temperatures ≤15°K with a neutron flux density 10^{13} cm^{-2} sec^{-1}. The data obtained were compared to corresponding data from irradiations at higher temperatures, together with a detailed study of the annealing behavior, to identify the basic mechanism of irradiation hardening. (C.E.S.)

24025 REVERSIBLE EFFECTS OF RADIATION ON DIELECTRIC PROPERTIES. V. M. Nesterov, E. S. Nesmelova, N. I. Ol'Shanskaya, T. G. Mikhailova, and G. I. Potakhova (Tomsk State Univ., Siberian SSR). Soviet Phys.-Solid State (English Transl.), 4: 2206-11(May 1963).

The results of an investigation of radiation-produced reversible changes in the dielectric properties are presented, and certain relations are pointed out between these changes and the structure of the dielectrics and the conditions of irradiation. (auth)

24026 THE ACTION OF IONIZING RADIATION ON CABLE RUBBERS. G. A. Blokh, V. L. Karpov, Yu. M. Malinskii, L. P. Ol'shanskii, and M. S. Khlopplyankina. Vestn. Elektroprom., No. 8, 52-8(1961).

The effect of direct ionizing radiation on different cable structures was studied as well as on insulation and rubber hoses subjected to irradiation in air, in vacuum, in water and at high temperatures. The insulation and hose were irradiated separately and in replicate with Co^{60} over a wide range of doses up to 500 Mrad, intensity 0.3 Mrad/hr. Ionizing radiation caused deterioration in the physicomechanical and dielectric properties of the cable rubbers. With increase in the radiation dose >50 Mrad, an abrupt fall in the specific elongation and an increase in hardness were observed. The rubbers maintained satisfactory durability and did not possess elasticity. Up to 50 to 100 Mrad irradiation in water or in vacuum, changes in the properties of the rubbers are considerably smaller. Rubbers from natural sources are more stable to the simultaneous action of heating and irradiation than those from nairit. (Referativnyy zhurnal, Khimiya, No. 8, 1962)

PHYSICS

General and Miscellaneous

24027 (AD-282604) A STUDY OF GAS-SOLID SUSPENSIONS AT HIGH TEMPERATURES AND EFFECT OF ELECTROMAGNETIC FIELDS. Technical Report ILL-7-P. S. L. Soo (Illinois. Univ., Urbana). June 1962. Project SQUID. Contract Nonr1858(25). 23p.

The equilibrium between thermionic emission from solid particles and space charges of the phases in a gas-solid suspension (thermal electrification) was previously studied. Some further considerations are examined. Investigation of the effects of the properties of the solid phase on thermal electrification indicates that solid particles in a gas-solid system could be much hotter than the gas phase since thermal electrification depends mainly on solid particle temperature. Control of thermal electrification by the initial charge of solid particles, particularly removal of electrons by positively charged particles, is considered. The rate of solid particle dispersion is found to be the main factor in deionization of hot gases by charged solid particles. Investigation of the electrical conductivity of a mixture of electrons, charged solid particles, and the gas atoms of the suspending gas reveals that thermal electrification is not the only contributor to high electrical conductivity. Use of a gas-solid system for magnetohydrodynamic energy conversion is also examined. Solid particles of controlled size contribute favorably to MHD generation, but in plasma MHD accelerators would reduce performance. (D.C.W.)

24028 (AD-286278) INVESTIGATION OF NON-THERMAL IONIZATION FOR MHD ENERGY CONVERSION. Quarterly Report No. 2, June 15–September 15, 1962. (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Contract AF33(657)-8298. 60p.

Results of two groups of experiments performed in cold cathode cesium diodes are given. The first group of experiments covered cesium–helium discharge phenomena in a diode configuration and were made to verify theoretical non-equilibrium concepts and formulations. The second group of experiments covered pure cesium discharges in a similar geometry and were conducted to answer questions concerning plasma conductivity, uniformity of discharge, and gradients produced in the positive column and the effect of wall conduction on the discharge. In the first case, it was possible to verify experimentally the theoretical work by showing that non-equilibrium phenomena did exist in select cesium–helium mixtures at current densities of 1–10 amp/cm^2 and that the experimental data closely matched the theoretical curve which represented values opaque to resonance radiation. For the pure cesium case, the experimental data checked within a factor of two for fully ionized condition. Loss of cesium to the walls of the container prevented accumulation of data above $1/3 \times 10^{16}$ cm^3. At a cesium density of $1/3 \times 10^{16}$ cm^3 it is shown that electrons having energies of the order of 0.18 ev must exist compared to gas temperature to be consistent with experimental data. Preliminary design and theoretical performance calculations for a potassium vapor MHD generator are also given. (auth)

24029 (AD-286324) THE DEVELOPMENT OF AN AUXILIARY ELECTRODE THERMIONIC CONVERTER. Quarterly Technical Report No. 3. W. B. Hall and J. J. O'Grady (Radio Corp. of America. Electron Tube Div., Lancaster, Penna.). Oct. 1962. Contract AF33(657)-8005. 63p.

Research was continued in an effort to determine the feasibility and to demonstrate the practicality of a three-electrode thermionic converter having the following characteristics: a third, positive ion-producing electrode, an efficiency of not less than 15%, an unattended life of not less than 1 year, and a maximum temperature of 1500°K. Several experimental converter designs were fabricated and evaluated. Refinements in geometry and processes were tested to achieve more dependable design criteria with the greatest emphasis directed toward the improvement in Cs purity. Materials investigations completed the Cs compatibility data for the initial materials selected and a comprehensive report is included. (auth)

24030 (AD-286693) UNIFORM WORK FUNCTION CATHODE STUDIES FOR THERMIONIC CONVERTERS. Quarterly Report No. 1. M. N. Huberman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 1962. Contract AF33(657)-8726. 25p.

Uniform work functions of thermionic converters were investigated. The performance of cylindrical converters that have emitters with uniform work function surface was evaluated. Chemical vapor deposition techniques were developed for the fabrication of nonplanar emitters of practical design that have improved uniformity of work function over the uniformity of work function of standard polycrystalline emitters. The development of thermionic converters having emitters of improved uniformity of work function may result in increased efficiency and power density. A converter test stand was assembled, equipment associated with the test stand was calibrated, and deposition samples were fabricated. (auth)

24031 (AD-286711) EVALUATION OF A MOLYBDENUM EMITTER, LOW VOLTAGE ARC THERMIONIC POWER CONVERTER. Quarterly Technical Progress Report No. 2. E. A. Baum (General Electric Co. Power Tube Dept., Schenectady, N. Y.). Oct. 1962. Contract AF33(657)-8323. 24p.

Evaluation of Mo emitters for low voltage arc thermionic converters was continued. The objective was to define and minimize the life-limiting and degradation factors affecting the usefulness of the low-temperature Cs vapor converter. Work on the program was directed toward a life test evaluation of a state-of-the-art, planar Cs vapor thermionic converter. Research was continued on a technical specification for a state-of-the-art vapor converter utilizing a Mo cathode. Effort was directed toward the design and fabrication of life test equipment suitable for obtaining meaningful data on the state-of-the-art Cs vapor thermionic converter as well as the fabrication of devices for test, and toward completion of the life test equipment, initiation of life tests, and the acquisition of operational data. (auth)

24032 (AFCRL-62-1015) THE HEIGHT DISTRIBUTION OF THE RATIO OF NEGATIVE ION AND ELECTRON DENSITIES IN THE LOWEST IONOSPHERE. Scientific Report No. 2. Bengt Hultqvist (Sweden. Kungliga Vetenskapsakademien. Geofysiska Observatoriet, Kiruna). May 6, 1962. Contract AF61(052)-601. 23p. (AD-286293)

Available experimental data on nondeviative absorption

and VLF propagation conditions in the twilight periods are reviewed. It is shown that there are no data to prove that the electron density is appreciably increased when the 60–90 kms altitude range is illuminated by near ultraviolet light but not by ionizing far ultraviolet radiation. Observations of the variation of auroral-type absorption show, on the contrary, that the photodetachment process does not increase the electron density within that height range by more than 10–20%. All observational results referable to the variation of nondeviative absorption and VLF propagation conditions over short distances during twilight periods may be comprehended in terms of 02 as the primary ion in the lowest ionosphere, provided the height distribution of the ratio of negative ion and electron densities is decreased so that even the night profile has the value 1 at about 60 kms. 31 references. (auth)

24033 (AFSWC-TDR-62-127(Vol.II)) ANALYSIS OF ARGUS BOMB DEBRIS. MATHEMATICAL MODEL. Final Report. R. K. M. Landshoff (Lockheed Missiles & Space Co., Sunnyvale, Calif.). Feb. 1963. Contract AF29(601)-4419. 87p.

A detailed description of the analytical methods used in constructing the Monte Carlo model and code is presented. The various mechanisms contributing to the energy losses of heavy particles moving through the atmosphere are reviewed, and it was concluded that for the cases of interest only the elastic collisions need to be taken into account. An outline is given of a statistical treatment of inelastic collisions together with a derivation of the corresponding probability distribution. The probability distribution for the beta decays of fission particles was derived. The logical construction of the code for the calculation of a history of a given particle is described. (auth)

24034 (ARF-1214-TR-2) A NUCLEAR-PHOTON ENERGY CONVERSION STUDY. Quarterly Technical Report No. 2, July 1, 1962 to September 30, 1962. H. V. Watts and S. Nudelman (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 9, 1962. Contract AF 33(657)-8527. 20p. (AD-286024)

The characteristics of silicon p-n junction photovoltaic cells were experimentally studied to determine their operational properties for use in a nuclear-photon energy conversion system. Beta particles from a radioisotope source are absorbed by a luminescent material which emits a multiplicity of low energy photons. These photons are converted to electrical energy by a photovoltaic device. Gamma radiation from Co^{60} produced a significant efficiency loss above 100,000 r. The silicon cell efficiency was observed to decrease nearly linearly with increased temperature in the range of 25 to 180°C at a rate of about 0.65% per degree centigrade. A marked efficiency decrease at low illumination intensities, which is expected from the beta excited phosphor, was observed for the silicon cell tested. (auth)

24035 (GA-3562(Rev.)) HIGH-TEMPERATURE VAPOR-FILLED THERMIONIC CONVERTER. Quarterly Technical Progress Report, July 1 through September 30, 1962. W. Godsin (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Nov. 10, 1962. Contract AF 33(657)-8563. 14p. (AD-289805)

The post-test analysis of Cell E was completed with the exception of the microprobe analysis of the emitter structure. Interpretation of data from the analysis indicated the necessity of improving the cleanliness of future cell assemblies and especially the need for techniques to determine the emitter condition throughout final assembly. A 10 UC–90 ZrC emitter was installed in Cell F. Thermocouple installation and calibration and high-temperature vacuum emission tests are being conducted prior to the final closure of the cell. A second cell structure, Cell G, is on hand and an emitter will be installed pending the results of surface preparation. Vacuum emission studies carried out under other contracts on three UC compositions, 10 UC–90 ZrC, 30 UC–70 ZrC, and 90 UC–10 ZrC, demonstrate that emission behavior is essentially independent of bulk uranium content. Intentional "poisoning" of the surface of sample emitters was produced by exposure to air at room temperature. These findings were substantiated on the Mark V-E and V-F emitters. It was concluded, therefore, that the emitter surface must be activated in addition to providing a clean cell environment during operation. (auth)

24036 (GEMP-200) COMPUTER PROGRAMS DESCRIBING COLLISION CASCADES IN BINARY MATERIALS. II. WURTZITE STRUCTURE. D. G. Besco and J. R. Beeler, Jr. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Feb. 1963. Contract AT(40-1)-2847. 50p.

An IBM 7090 computer program calculates the results of knock-on cascades initiated by the injection of a single atom into a binary solid. The program represents an extension to the real wurtzite structure of beryllium oxide, of an earlier calculation in which, for simplicity, the cascade was confined to a square planar lattice. Interactions between atoms are computed using a hard sphere approximation to the Bohr screened coulomb potential. Output from the computer includes a complete cascade history, including range and displacement statistics, and a listing of the final pattern of point defects. The program is designed to assist in interpreting the results of ion bombardment experiments on BeO. (auth)

24037 (HW-76128) PHYSICS RESEARCH QUARTERLY REPORT, OCTOBER–DECEMBER 1962. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 15, 1963. Contract AT(45-1)-1350. 69p.

An expression for the variational optimum kinetic response representation of reactors was obtained, and Gaussian quadrature methods integrated over a logarithmic grid were used to numerically integrate the Egelstaff S-function. The effects of small differences in the concentration of the Pu^{240} isotope in Pu–Al fuel rods on criticality were studied using a cylindrical lattice array with two zones. Critical approaches and exponential measurements were used in the experiments. Extrapolation lengths as a function of fissionable materials and calculated and measured numbers of rods required for criticality were obtained. Results indicate that the critical mass of Pu either varies more strongly with Pu^{240} concentration than the calculations show or that a systematic error is present. The P-3 computer program was used to calculate thermal fluxes in lattices with Al–Pu fuel clusters for both poisoned and unpoisoned cases. Values of η thermal and f, the thermal utilization, were calculated. Similar calculations were performed on a lattice fueled with PuO_2–UO_2. Sensitivity of the calculated flux traverse to perturbations in input parameters was also investigated. A series of PCTR experiments was analyzed using a multi-energy transport group code to derive values of k_∞ for Al–Pu fueled moderated lattices and to predict reaction rates for various resonance detectors throughout a lattice cell. Cadmium ratios at cell boundaries were derived and were found to fall short of measured values. Results of an experiment in which 19 rod clusters of both high and low exposure Al–Pu fuel were heated were analyzed to obtain values for the difference in the change in

the neutron multiplication factor as a function of temperature, and values of the effective resonance integral as a function of temperature were calculated. Measurements of the reactivity coefficients of Al–Pu fuel rods were made in the PCTR to verify the relative Pu content as given by chemical analysis and to investigate the uniformity of Pu concentration. The momentum distribution of β particles from the decay of Lu^{176m} was measured; two components with relative intensities of 44 and 56% were identified. Internal-conversion electrons from Hf^{176} L and M shells were observed for an 88.4 kev γ transition also. A ratio of the intensity of the L to M electrons of 3 ± 0.3 was obtained. A value of zero was selected for the quantum number k of the Lu^{176m} level. Critical mass measurements were continued on plutonium nitrate solutions in a 14-inch diameter sphere to determine the effects of concrete reflectors on the criticality of the vessel and the effect of an air gap between these reflectors and the core. The results verify that a 10-inch layer of concrete is a better reflector than water; the critical concentration was about 10 to 12% less than when the sphere is reflected with water. The effect of an air gap between the core and reflector varied with Pu concentration and total nitrate. Experiments with a water-reflected sphere were also performed. (D.C.W.)

24038 (JINR-E-1204) ON LOCAL QUANTUM FIELD THEORY WITHOUT ULTRAVIOLET DIVERGENCES. G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 14p.

It is assumed in the quantum theory of the scalar field that the difficulties of the local theory associated with the presence of the ultraviolet divergences in perturbation theory stem from the behavior of the interaction Lagrangian $L_I(\phi)$ for large values of the fields ϕ of scalar particles. It is necessary to consider only those interaction Lagrangians that increase slower than the free Lagrangian, as ϕ^2 increases. It turned out to be possible to introduce such local non-linear interaction Lagrangians that would satisfy certain requirements and for which the ultraviolet divergences would be absent in second order perturbation theory. As an example the correction to the mass of a scalar particle is calculated. (auth)

24039 (LA-2886) CESIUM WAVE FUNCTIONS. Philip M. Stone (Los Alamos Scientific Lab., N. Mex.). Apr. 1963. Contract W-7405-eng-36. 42p.

Radial wave functions for the ground state and excited states of cesium are presented in tabular form. They are obtained by numerical solution of a one-electron Schrödinger equation with a central, spherically symmetric potential. The potential and the numerical procedures were discussed in a previous report. (auth)

24040 (LNF-63/5) ABERRAZIONI IN OTTICA DEI MAGNETI A SIMMETRIA DI RIVOLUZIONE (ESTRATTO DALLA TESI DI LAUREA). (Optical Aberrations of Magnets with Revolution Symmetry (Extracted from the Doctorate Thesis)). Note No. 185. P. Giupponi (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Feb. 4, 1963. 19p.

The problem of aberrations occurring in corpuscular optics when the conditions of the linear approximation are not satisfied is studied. The equations describing these aberrations in optical systems with revolution symmetry are derived from the first-order electron optical equations and from third-order aberration equations. Programming for the computer calculation of the aberration coefficient is indicated. (J.S.R.)

24041 (MND-2866-1) RESEARCH PROGRAM ON MAGNETOHYDRODYNAMIC ELECTRIC POWER GENERATORS WITH AUXILIARY IONIZATION. Quarterly Progress Letter No. 1, June 15–September 15, 1962. W. B. Bienert and C. Shih (Martin-Marietta Corp. Aerospace Div., Baltimore). Sept. 24, 1962. Contract Nonr-3866(00). 4p. (AD-285849)

Design of experimental apparatus to test the auxiliary ionization approach to magnetohydrodynamic (MHD) power generation continued. Necessary equipment was ordered, and instrumentation for the MHD loop was designed. Conductivity of a Cs–He plasma was tested in a discharge tube arranged similarly to the actual generator duct. Also, the operating characteristics of the MHD loop were analyzed. (D.C.W.)

24042 (NASA-TN-D-1654) VARIATIONAL APPROACH TO THE CALCULATION OF CHARGE EXCHANGE CROSS SECTIONS FOR ADIABATIC COLLISIONS. Frederick E. Alzofon and Fred C. Witteborn (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.). May 1963. 10p.

Cross sections for the reaction $H^+ + H(1s) \rightarrow H(1s) + H^+$ are calculated for incident particle energies between 10 ev and 2250 ev using an impact parameter method. The required electronic energy levels were found by varying one parameter in the molecular ion wave function at every value of proton separation. The resulting cross sections are compared with those obtained using more accurate wave functions and with experimental data. (auth)

24043 (NASA-TN-D-1657) CHARGE-EXCHANGE EFFECTS ON THE ACCELERATOR IMPINGEMENT OF AN ELECTRON-BOMBARDMENT ION ROCKET. William R. Kerslake (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1963. 44p.

A systematic investigation of accelerator-grid-ion impingement was made with electron-bombardment ion rockets operated over a range of propellant utilization efficiencies from 0.11 to 0.95. Three ion rockets of 5, 10, and 20 cm in diameter were used to produce mercury-ion beams of 0.01 to 0.55 amp at net accelerating potentials of 600 to 7000 v. Experimental impingement values were near those predicted by ion charge-exchange equations, particularly below propellant utilization efficiencies of 0.6. Calculations were made to estimate the maximum lifetime of a molybdenum accelerator grid based upon the rocket operation parameters. (auth)

24044 (NP-12763) HIGH TEMPERATURE THERMOELECTRIC RESEARCH. Fifth Quarterly Progress Report, January 1–March 29, 1963. C. M. Henderson (Monsanto Research Corp. Dayton Labs., Ohio). Contract AF 33(657)-7387. 47p.

An experimental model 5-w (nominal) generator completed 2556 hrs of a sustained performance test at a hot-end temperature of 1200°C (+25°C, –4°C), cold end at 714°C (+12°C, –0°C), in a vacuum of 10^{-5} to 10^{-6} mm Hg without degradation in power producing characteristics. The power/weight ratio of this generator, exclusive of heat source, ranged from 2.70 to 2.86 watt/lb. Graphite-ended segmented modules of n- and p-type thermoelectric materials to supplement p-type MCC 50, the thermoelectric material used in the 5-w generator, were fabricated and partially evaluated. The first such p-n couple produced 250% more power than the p-type MCC-molybdenum couple used in the 5-w generator. Improved emissive coatings and lightweight junctions between modules were produced. These developments suggest that an advanced experimental 50-w generator having a power/weight ratio of 10–20 watt/lb is feasible. (auth)

24045 (NP-12790) RESEARCH ON THE VORTEX MHD POWER GENERATOR. Fourth Quarterly Progress

Report. W. C. Davis and R. T. Craig (TAPCO. Div. of Thompson Ramo Wooldridge, Inc., Cleveland). Apr. 1963. Contract NAS3-2526. 27p. (ER-5324)

The experimental model of the vortex magnetohydrodynamic generator operated satisfactory, approximately as indicated by the initial design study. The study of the various magnet systems for application to the vortex MHD generator has placed initial emphasis on permanent magnet structures. Calibration of the vortex chamber device was completed and preliminary measurements of the turbulence effects on velocity distributions within the vortex were completed. A numerical simulation of the vortex MHD generator was established for an IBM 7070 computer. A first attempt to estimate the reliability and wear out lifetime of a possible MHD system was completed. The results are encouraging but by no means complete. (auth)

24046 (NP-12791) FEASIBILITY STUDY TOWARD DEVELOPMENT OF RADIATION-RESISTANT SOLAR CELL. Monthly Report, January 1, 1962–January 31, 1962. S. Kaye (Electro-Optical Systems, Inc., Pasadena, Calif.). Feb. 15, 1962. Contract NAS7-92. 13p. (EOS-2080-ML-3)

Fabrication of graded-base and ungraded-base control cells has continued. Measurements of the v-i characteristics of the cells were made under illumination and spectral response curves were taken. Measurements were made of junction capacitance and lifetime after diffusion. Cells tested have efficiencies of about 5%. (auth)

24047 (NP-12792) VAPOR-FILLED THERMIONIC CONVERTERS. Second Quarterly Report, January 1 to March 31, 1963. K. G. Hernqvist and J. R. Fendley (Radio Corp. of America. RCA Labs., Princeton, N. J.). Apr. 20, 1963. Contract NAS 3-2531. 20p.

Studies of the plasma density variation with discharge current are described both for a synthesized cesium plasma and for a cesium arc discharge. Microwave measurements using the plasma as a post across a rectangular waveguide give results that are in good agreement with theory. Preliminary experiments with a gas-analysis, gas-dosing system are described. It is seen that hydrogen is the principal gas evolved during cesium diode operation. The experimental verification for ball-of-fire analysis of the cesium arc discharge is summarized. The theory is extended and compared with experiment to yield values of excitation coefficients for cesium, optical radiation intensity from the glow plasma, and optimum diode spacing. (auth)

24048 (NP-12795) ON THE ORIGIN OF THE ANOMALOUS PHOTOVOLTAIC EFFECT IN ZINC SULFIDE. Frank A. Junga (Lockheed Missiles & Space Co., Sunnyvale, Calif.). May 1, 1963. Contract Nonr-222(57). 87p.

Earlier models are shown to fail to account for all the features of the anomalous photovoltaic effect (APE). Specifically, both Tanc's model and Neumark's model could not account for the anomalously high voltages at both the positive and negative peaks, and the effect of polarized light on the spectral response curve. In addition, Tanc's scheme to add elemental voltages proved to be inadequate. The only objection to Hutson's model was that it was incomplete. By extending Hutson's model and formulating the problem in terms of independent photovoltage generators in each segment of the crystal, all the features of the spectral response of the APE can be taken into account. Briefly, the present model correctly predicts the shape of the spectral response curve, the wavelengths at which the photovoltage changes polarity, and the general position of the photovoltage maxima. Furthermore, the model predicts the correct dependence of photocurrent on the polarization of incident light and the shift of λ_{OV} and λ_{OR} with temperature and light intensity. The expression derived for the dependence of the photovoltage on an external applied stress, together with the results of the stress experiments on mixed crystals, verifies the assumption of the origin of the photovoltage, viz., that the photovoltages arise from piezoelectric fields set up by permanent internal strains formed during the growth process. An experiment on single crystal hexagonal ZnS not only added strength to the proposed origin of the APE, but also successfully tied together the information on the direction of crystal growth, pyroelectric effect, and the positive peak polarity. The experiment also verified the calculation of the photovoltage generated in a non-uniformly strained piezoelectric crystal. In general then, the proposed model is quite successful; the main weakness of the model being the fact that the photovoltage depends on the internal strain gradients, quantities that cannot be independently measured. 39 references. (auth)

24049 (NRL-Memo-1404) STATUS REPORT ON THERMOELECTRICITY. J. W. Davisson and Joseph Pasternak (Naval Research Lab., Washington, D. C.). Mar. 1963. 107p.

Progress is reported on materials research and development including preparation of high-temperature broad-band semiconductors, research on high-temperature semiconducting compounds for thermoelectric power generation, structural investigations in thermoelectric materials, studies of thermoelectric properties of selenides and tellurides, high-temperature metallurgy research on thermoelectric materials, development of a semiconductor film-type thermocouple converter, development of a thermoelectric nuclear fuel element, preparation of a Sr^{90}-fueled thermoelectric generator power source for 5w U. S. Coast Guard light buoy, testing of solar thermoelectric panels, design and application of Peltier heat pumps, module improvement program, and studies of bonding Be-clad UO_2 fuel elements. (M.C.G.)

24050 (NYO-10425) ON THE EIGENVALUE PROBLEM $Tu - \lambda Su = 0$ WITH UNBOUNDED AND NONSYMMETRIC OPERATORS T AND S. W. V. Petryshyn (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). Jan. 15, 1963. Contract AT(30-1)-1480. 89p.

A general eigenvalue problem (i) $Tu - \lambda Su = 0$, where T and S are some linear (in general unbounded and non-selfadjoint) operators in a complex or real Hilbert space are investigated from the point of view of the existence of eigenvalues and eigenvectors of (i) and their approximate calculation. After a study of the properties of a certain class of K-positive definite and K-real operators, these properties are used to investigate the problem of existence of eigenvalues and eigenvectors of (i) and their properties under various conditions on T and S. The applicability and the unifying property of the generalized method of moments for the approximate solution of (i) is proved, and a fairly general iterative method for the approximate solution of (i) that does not require the preliminary reduction of (i) to an equivalent problem with bounded operators is presented and examined. The above study permits formulation of eigenvalue problems and solution of them approximately also for the case when T and S are nonsymmetric differential operators of an odd or even order. 38 references. (auth)

24051 (NYO-10428) THE INFLUENCE OF MOMENTUM EXCHANGE ON THE PROPAGATION OF DISTURBANCES IN A MULTICOMPONENT FLUID. Richard L.

Liboff (New York Univ., New York. Courant Inst. of Mathematical Sciences). Apr. 1, 1963. Contract AT (30-1)-1480. 25p. (MF-35)

One-dimensional perturbations of a two-component neutral fluid about absolute Maxwellian equilibrium states (with equal temperatures) are examined. The starting equations are two Boltzmann equations coupled through difference-in-velocity terms. A Fourier-Laplace transform analysis indicates that the resulting modes are all strongly damped. It is concluded that a momentum exchange mechanism alone cannot support the collective sound mode. Asymptotic forms for decay frequency are found for small and large k waves. A thermodynamic estimate is given for the sound speed of a multi-component gas in which the number of degrees of freedom of each component is distinct. (auth)

24052 (ORNL-3422) ALPHA PARTICLE IONIZATION OF ARGON MIXTURES—FURTHER STUDY OF THE ROLE OF EXCITED STATES. T. E. Bortner, G. S. Hurst, Mildred Edmundson, and J. E. Parks (Oak Ridge National Lab., Tenn.). May 23, 1963. Contract W-7405-eng-26. 58p.

The average energy required to form an ion pair, W, when alpha particles are absorbed in mixtures of argon with other gases is studied. The other gases were selected on the basis of their ionization potentials. One group consists of representative gases that have ionization potentials below that of Ar (15.77 ev) and above the doublet metastable state of Ar (11.49 and 11.66 ev). This list includes methane, carbon dioxide, nitrous oxide, xenon, and krypton. The other group of special interest consists of some gases with ionization potentials below the metastable state of Ar. All gases tested in these two groups cause an increase in ionization, i.e., a decrease in W, when added to argon. As an illustration of this effect, the addition of $\frac{1}{2}\%$ of acetylene to Ar will increase the ionization by 23%. The experimental data, i.e., W as a function of relative concentration of the two gases, were fitted to a model in which it is assumed that energy is transferred from two excited levels in argon to the additive gases in collision processes. Good agreement between the experimental data and calculations based on the model is taken as additional evidence that the excited state notion is correct. A quantity of particular interest, the ionization efficiencies for the additive gases, was derived from the data fitting procedure and compared with those found in photoionization studies in a few of the cases. (auth)

24053 (ORNL-3432) ELECTRONUCLEAR DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1962. (Oak Ridge National Lab., Tenn.). May 24, 1963. Contract W-7405-eng-26. 95p.

Heavy-ion reactions in the low-Z region were investigated with 27-Mev nitrogen ions from the 73-inch Cyclotron and with 30-Mev oxygen ions from the Tandem Van de Graaff. Experiments included studies of angular distributions and excitation functions for transfer reactions, compound-nucleus reactions, effects of angular momentum on the density of nuclear states, and so-called Ericson fluctuations in the compound nucleus Si^{28}. Nuclear reactions induced with 22-Mev protons in the 86-Inch Cyclotron were used in studies of the pickup-reaction mechanism, shell-model studies from pickup reactions, scattering and the optical model, and level schemes in highly deformed nuclei. In theoretical investigations of the mechanisms of nuclear reactions and related nuclear-structure information, the elastic scattering of complex particles was analyzed via the optical model; the applicability of the distorted-wave method to stripping reactions was investigated, and the inelastic scattering of carbon ions from carbon was examined. Experimental studies with the eight-sector electron model, Analogue II, led to very successful deflection of the beam in November 1962, a significant advance in accelerator technology. This investigation, still incomplete, eases one of the major uncertainties associated with the proposed Mc^2 cyclotron. The radioactivity resulting from the residual undeflected beam being dumped onto the structure of the cyclotron can now be estimated much more reliably. Successful test operation of the Oak Ridge Isochronous Cyclotron (ORIC) at full radius in March 1962 verified the design of the azimuthally varying magnetic field, which is expected to provide for fixed-frequency operation for proton energies up to 75 Mev. During these test operations at 8 Mev, the properties of the beam at full radius were explored, and the beam was brought through an electrostatic deflector channel. The machine was then shut down for the installation of the full-power r-f system and the beam-extraction components. Investigation of basic problems connected with the design of large magnets with Nb–Zr superconductors was continued. It was found that the use of a copper secondary, bifilar wound with the superconductor, and the use of epoxy casting, to rigidly confine the windings, markedly increase the current capacity of the magnet and eliminate the damage usually encountered when the superconductor goes normal. (auth)

24054 (SCR-623) TRANSIENT ELECTROMAGNETIC FIELD PROPAGATION THROUGH INFINITE SHEETS, INTO SPHERICAL SHELLS, AND INTO HOLLOW CYLINDERS. C. W. Harrison, Jr. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1963. Contract AT(29-1)-789. 55p.

Gaussian electromagnetic field pulses of several durations are propagated through infinite sheets, into the interior of hollow cylinders, and into the interior of spherical shells. The plates, spheres, and cylinders contain no slots. The time history of the propagated pulses is computed. Finally, the field is calculated in the interior of a cylinder of finite length when connected at its ends by wire to a generator delivering a current pulse of gaussian shape. The dimensions of the cavities are assumed to be sufficiently small that resonances are not excited by the highest significant frequency contained in the shortest pulse considered. The numerical study is restricted to thin-walled aluminum shields $\frac{1}{32}$, $\frac{1}{16}$, $\frac{1}{8}$, and $\frac{1}{4}$ inch thick. The half-amplitude widths of the pulses employed lie in the range 14 to 2400 μs. It is shown that gaussian pulse electric fields defined on the surface of the plates and cylinders are propagated with little diminution in amplitude. When the incident pulse undergoes reflection at the boundary surface as well as transmission through the metal wall, the total attenuation sustained by the field is great. Thin spherical shells form effective magnetic shields. The electric field is small in the interior of thin-walled cylinders carrying extremely large transient currents. (auth)

24055 (TID-18644) STUDIES OF H_2^+ DISSOCIATION. Phase III. Quarterly Progress Report No. 2, February 15, 1963 through May 14, 1963. A. W. Ehler (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). May 12, 1963. Contract AT(04-3)-362. 7p.

Over 150 measurements of the H_2^+ dissociation fraction vs electric field were made for fields of 275,000 to 620,000 ν/cm. The dissociation fraction was constant at 0.0035 for fields less than about 350,000 ν/cm. As field strength increased from this level to 565,000 ν/cm, the fraction increased linearly to 0.0046. For the higher fields utilized, the fraction was again constant. Experimental results ob-

tained so far agree with Hiskes' theoretical calculations for the 17th vibrational level of the H_2^+ ion with no rotational effects apparent. (D.C.W.)

24056 (TID-18658) THEORY OF THE KNIGHT SHIFT AND FLUX QUANTIZATION IN SUPERCONDUCTORS. L. N. Cooper, H. J. Lee, B. B. Schwartz, and W. Silvert (Brown Univ., Providence). [May 1962]. Contract AT (30-1)-2262. 11p.

Consequences of a generalization of the theory of superconductivity that yields a finite Knight shift are presented. In this theory, by introducing an electron-electron interaction that is not spatially invariant, the pairing of electrons with varying total momentum is made possible. An expression for χ_s (the spin susceptibility in the superconducting state) is derived. In general χ_s is smaller than χ_n, but is not necessarily zero. The precise magnitude of χ_s will vary from sample to sample and will depend on the nonuniformity of the samples. There should be no marked size dependence and no marked dependence on the strength of the magnetic field; this is in accord with observation. The basic superconducting properties are retained, but there are modifications in the various electromagnetic and thermal properties since the electrons paired are not time reversal conjugates of one another. In particular the consequences of this generalized theory on flux quantization arguments are presented. (auth)

24057 (TID-18671) CIRCUIT MODEL OF FIELD THEORY. Special Report. B. R. Gossick (Arizona State Univ., Tempe). May 1963. Contract AT(11-1)-715. 37p.

A variation of field theory is presented in terms of electric circuits. A hamiltonian representing electromagnetic terms is stated, the eigenfunction of which represents the vacuum in the ground state and electrons and positrons in the first excited state. The method is extended to treat collective interactions, e.g., between valence electrons in a metal. (auth)

24058 (WCAP-1820) THERMOELECTRIC NUCLEAR FUEL ELEMENT QUARTERLY PROGRESS REPORT, APRIL–JUNE 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). July 10, 1961. Contract AT (30-3)-500. 47p.

Uranium-bearing thermoelectric compounds are now being prepared by tantalum bomb melting and by the hydride process. Tests of devices made up from these compounds indicate that the main fabrication problems are densification and contact bonding. Data from a hot-swaged pellet and a swaged device of US_2 indicate some promise for that compound. Improvements in techniques of thermoelectric parameter measurements include programming of automatic test data recording at desired intervals around the clock; increased accuracy and versatility of measurements through use of a newly-constructed adjustable precision resistor; and a method for measuring which should lead to an experimental means for determining the thermoelectric figure of merit, Z. Potential profile studies on PbTe pellets are yielding important information on contact resistance parameters. A fission-fired thermoelectric generator is being prepared for the next in-pile test. (auth)

24059 (UCRL-6450(Rev.1)) EQUATION OF STATE OF CLASSICAL SYSTEMS OF CHARGED PARTICLES. S. G. Brush, H. E. DeWitt, and J. G. Trulio (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 21, 1962. Contract W-7405-eng-48. 57p.

Recent developments in the classical theory of fully ionized gases and strong electrolyte solutions are reviewed, and are used to discuss the equation of state at high temperatures and low densities. The pressure is calculated using the ring-integral approximation, and quantitative estimates of higher correction terms are given. The effect of short range repulsive forces is shown by comparing the results with two kinds of potential functions: hard spheres of diameter $\underline{a}$, and "soft" spheres for which the short range potential cancels the Coulomb potential at the origin, and decreases exponentially with distance. It is found that the use of either type of potential extends the range of validity of the ring-integral approximation to considerably higher densities and lower temperatures. Since there is little difference in the results for the hard spheres and the soft spheres in this range, the latter system is investigated more extensively since it is more easily handled by analytical methods. The expressions derived for the free energy of a system of charged particles can also be used in ionization equilibrium calculations, and the effect of electrostatic interactions on the equilibrium concentrations of various kinds of ions is indicated. 60 references. (auth)

24060 (UCRL-6635) IGNITRON DISCHARGE GROWTH DURING HIGH-CURRENT PULSES. David B. Cummings (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 1, 1962. Contract W-7405-eng-48. 28p.

Kerr-cell photographs were taken of glass ignitrons carrying up to 21,000 amperes with rise times as short as 1.25 μsec. These show growing striations, occasional pinches, and a circle of arc spots that spreads out from the ignitor with velocities up to 2×10^6 cm/sec. The peak velocity was proportional to the 0.7 power of capacitor voltage and directly proportional to the noninductive component of tube voltage drop. The effects of ringing frequency and temperature were determined. Plasma floating potential was measured with an auxiliary anode. A model for the arc-front propagation mechanism is proposed which includes arc-spot formation by Malter-effect. Calculations of this model are consistent with the measured velocities. 36 references. (auth)

24061 (UCRL-9845(Rev.)) COLOR PRODUCTION FROM ENERGETIC IONS IMPINGING ON METALS. Kenneth W. Ehlers (California. Univ., Berkeley. Lawrence Radiation Lab.). June 25, 1962. Contract W-7405-eng-48. 32p.

It was observed that energetic gaseous ions mark their region of impingement on certain metals in color. Under identical conditions of bombardment, multicharged ions of the same gas mark their impact areas with different colors. The colors are sensitive to the type and energy of the ion as well as to the metal bombarded. These colors may result from reflections from thin films formed by reactions at the target. Because the colors indicate that thicker films are produced with increased ion energy, ion penetration depth as predicted by theory is compared with the depth indicated by the colors observed. (auth)

24062 (UCRL-10402) SUPERCONDUCTING CRITICAL CURRENTS IN WIRE SAMPLES AND SOME EXPERIMENTAL COILS. Richard C. Wolgast, H. Paul Hernandez, Paul R. Aron, Harley C. Hitchcock, and Kenneth A. Solomon (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 2, 1962. Contract W-7405-eng-48. 20p.

Critical current measurements on Nb–Zr alloys, a Nb–Ti alloy, Ta–Ti alloys, and Nb_3Sn cored wire in steady fields up to 93.5 kgauss are summarized. The construction and performance of six experimental superconducting coils are described. Critical currents of 25 amp were obtained in two coils, each wound with 0.010-in.-dia. Nb–25 at. % Zr wire more than 8,000 ft long. (auth)

24063 (UCRL-10445) THE SCALE TRANSFORMATION IN PHYSICS. Daniel M. Greenberger (California.

Univ., Berkeley. Lawrence Radiation Lab.). Aug. 29, 1962. Contract W-7405-eng-48. 33p.

Some criteria are established to test whether invariance under a continuous transformation will lead to a conservation law. The scale transformation is examined as a special case, and shown not only to lead to no general conservation law, but also in fact to be of a trivial nature. This is due to the rather artificial way in which scale invariance is usually introduced. A theory is then constructed by introducing an internal coordinate of dimension (length) in order to allow only the dimensionless ratio of lengths to enter; and by exploiting the gauge-like structure of the scale transformation. In this theory the scale transformation does lead to a new conserved current (as well as to an "almost conserved" one), and the internal coordinate is shown to play the same role for the scale transformation as the internal coordinate spin plays for the case of rotations. (auth)

24064 (WCAP-1865) THERMOELECTRIC NUCLEAR FUEL ELEMENT QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Oct. 10, 1961. Contract AT(30-3)-500. 38p.

Samples of makeup compositions U_2S_3, U_2Se_3, U_3Se_5, U_3Te_4, and UTe_2 were prepared by solid-vapor reaction process. In addition, the following samples were melted in sealed tantalum bombs at the indicated temperatures: U_3Se_4, 1800°C; UTe_2, 1480°C; U_3Te_4, 1430°C; and UTe, 1490°C. A U_3S_5 sample was run to 1800°C in the 2500°C high vacuum furnace, at which point the bomb failed, resulting in severe damage to the tantalum furnace parts. Thermoelectric properties of the above compounds indicate their uses for thermoelectric fuel elements. The theory and development of the Z-meter were described by thermoelectric measurements. Thermoelectric measurements were indicated for PbTe, Bi_2Te, and USeTe. Radiation effects studies on lead telluride elements were completed and reported. Design and fabrication of nine PbTe elements were evaluated. (N.W.R.)

24065 (FTD-TT-62-666) THERMIONIC ENERGY CONVERTERS. I. I. Damaskine and G. A. Chetverikova. Translated from Teploenerg., No. 3, 82-6(1962). 11p. (AD-286572)

Operational principles of thermionic converters are briefly discussed, and the need for low anode work functions is pointed out. Ways for overcoming electron space charge are examined, and results of studies of the operation of various diodes are reviewed. Preliminary results of an investigation of a converter consisting of a glass tube in which a W strip cathode and a Ni anode are arranged coaxially and are separated by 1.3 mm are given. Operating with a Cs vapor at a pressure of 10^{-2} mm Hg, an efficiency of 4% was obtained. (D.C.W.)

24066 (JPRS-19316) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION, RADIOPHYSICS SERIES. Translation of Izvestiya Vysshikh Uchebnykh Zavedenii, Radiofizika, 5: No. 6, 1051-1250(Nov.-Dec. 1962). 460p.

Separate abstracts were prepared for nine of the twenty-five papers and communications included; one paper was previously abstracted in NSA. The remaining papers deal with electric characteristics of earth rocks, antiferromagnetic and ferromagnetic resonance theory, electromagnetic shock waves in nonlinear lines, antenna arrays with arithmetically progressive separation of radiators, operating modes and effects of two harmonic voltages in self-oscillators, fluctuation phenomena in oscillations in generators, stability of solutions of quasi-stationary systems of linear differential equations, periodic motion from an equilibrium on a discontinuity surface, effect of oscillating ground mass on vibration ramming, determination of the optimal variable parameter of a linear system with finite memory, theory of the external photoeffect from semiconductors with large photoelectron work functions, and a two-position regulator with correcting sign transmitter. (D.C.W.)

24067 (JPRS-19316(p.1-15)) SPECTRUM OF NON-THERMAL COSMIC RADIO EMISSION AND THE NATURE OF THE ELECTRONIC COMPONENT OF PRIMARY COSMIC RAYS. G. G. Getmantsev. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 1051-6(Nov.-Dec. 1962).

The reasons for the variation of the frequency spectrum of cosmic radio emission with variation of the frequency, observed by Baldwin, are discussed. They can be explained by assuming that the galactic corona contains an appreciable fraction of a relic component of relativistic electrons. (auth)

24068 (JPRS-19316(p.28-50)) RADIATION OF NON-EQUILIBRIUM PLASMA. F. V. Bunkin. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 1062-71 (Nov.-Dec. 1962).

The intrinsic (fluctuation) radiation of a nonequilibrium plasma (stationary, and also periodically nonstationary) due to the collision effect is considered. (auth)

24069 (JPRS-19316(p.51-63)) ENERGY LOSSES OF A CHARGED PARTICLE IN A DIELECTRIC SLAB. V. E. (Ye.) Pafomov. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 1072-7(Nov.-Dec. 1962).

The spectral distribution of the energy losses of a relativistic charged particle passing through a thin dielectric slab was calculated. It is shown that the energy is lost at frequencies corresponding to the absorption bands. The distribution of the absorbed energy in the slab is determined. (auth)

24070 (JPRS-19316(p.64-98)) PASSAGE OF FAST PARTICLES THROUGH A MAGNETO-ACTIVE PLASMA. V. N. Tsytovich. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofizika, 5: 1078-92(Nov.-Dec. 1962).

The interaction between radiation and a fast particle passing through a magneto-active plasma is analyzed. Radiation probabilities are derived from which particle energy losses can be determined. (auth)

24071 (JPRS-19316(p.125-46)) CONTRIBUTION TO THE THEORY OF FLUCTUATIONS IN MAGNETOHYDRODYNAMICS. Yu. A. Kurochkin. Translated from Izv. Vysshikh Uchebn. Zavedenii Radiofizika, 5: 1104-14(Nov.-Dec. 1962).

Fluctuations of various physical quantities in a magnetohydrodynamic medium are considered. The spectral distributions of the correlation functions are determined for the fluctuations of the density, the velocity components, the current, the magnetic field, and other quantities with account of conductivity, viscosity, and heat conduction of the medium. (auth)

24072 (JPRS-19316(p.162-76)) ENERGY LEVELS AND RELATIVE INTENSITIES OF NUCLEAR SPIN RESONANCE LINES IN SINGLE CRYSTALS. N. E. (Ye.) Aynbinder and V. S. Grechishkin. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 1123-9(Nov.-Dec. 1962).

Nuclear spin resonance levels are calculated for small

deviations from the principal axes of the tensor of the electric field gradient of the crystal, using $Na_2S_2O_3 \cdot 5\ H_2O$ as an example. The method of the zero-splitting cone for spin $J = 3/2$ is extended to include the case of arbitrary external magnetic field. Expressions are given for the "mirror" energy levels, and their intensities are presented for the particular case $\eta = 0$; for spin $J = 1/2$ (in weak magnetic fields) the zero splitting parameters are tabulated. A comparison is made between theory and experiment. (auth)

24073 (JPRS-19316(p.227-47)) INTERACTIONS BETWEEN ELECTRONS AND THE FIELD OF A STANDING TEM WAVE AT LARGE TRANSIT ANGLES. B. G. Yeremin and M. A. Miller. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 1151-9(Nov.-Dec. 1962).

The results of a numerical calculation of the characteristics of the electron gap at large transit angles are analyzed. The inside field has the form of a standing TEM wave that is transverse relative to the average electron trajectory. The values of the parameters under which effective interaction can take place are established. (auth)

24074 (JPRS-19316(p.248-72)) REFINEMENT OF AVERAGED EQUATION OF MOTION OF CHARGED PARTICLES IN THE FIELD OF A STANDING ELECTROMAGNETIC WAVE. A. G. Litwak, M. A. Miller, and N. V. Sholokhov. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 1160-70(Nov.-Dec. 1962).

The accuracy of the averaged description of motion of charged particles in spatially-inhomogeneous electromagnetic fields is investigated. For motion in the field of a standing electromagnetic wave, an averaged equation of motion was obtained accurate to the fourth degree of the small parameters. It is shown by means of particular examples that although the averaged force remains potential, the first integral of the average motion cannot be interpreted as an energy integral. (auth)

24075 (JPRS-19316(p.273-82)) CHARACTERISTICS OF PLANE ELECTRON GAP IN THE PRESENCE OF EXTERNAL FORCE FIELD. S. B. Mochenev. Translated from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 5: 1171-4 (Nov.-Dec. 1962).

The problem of the distribution of the potential and the passage of current in a plane electron gap in the presence of an extraneous force field is considered. Specifically, the problem deals with the averaged high frequency force field, although in principle all the results can be applied to a potential field of any other nature. For a parabolic distribution of the extraneous potential, the current cutoff characteristics on the collector are obtained. By recording the value of the reflecting voltage it is possible, as is well known, to determine the intensity of the high frequency field in the gap; the results obtained are therefore of interest in estimates of the accuracy of such measurements. (auth)

24076 PERFORMANCE EVALUATION OF A MAGNETICALLY SPUN d.c. ARC OPERATING IN NITROGEN. D. R. Boldman (National Aeronautics and Space Administration, Cleveland). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 802-5(Apr. 1963).

The results of an experimental investigation of a concentric cylinder-type electrode configuration incorporating a magnetic field indicated that the arc potential difference in nitrogen was essentially independent of the pressure in the range of 1 to 7 atm except for a specific range of operating conditions in which a 26% increase in arc potential difference was obtained. Highest efficiencies were achieved during the high potential operating mode. The independent effect of the electromagnetic force on the arc is not conclusive; however, experiments in which the magnetic field strength was varied over a moderate range indicated the importance of optimizing this effect from the standpoint of both chamber efficiency and arc stability. Photographs of the arc reveal some of the effects of varying the magnetic field strength. The arc chamber efficiency was influenced also by the flow injection mode. An increase in efficiency was obtained when the flow opposed or was normal to the direction of the Lorentz force. (auth)

24077 PROPULSION APPLICATION OF THE MODIFIED PENNING ARC PLASMA EJECTOR. W. D. Kilpatrick, J. H. Mullins, and J. M. Teem (Electro-Optical Systems Inc., Pasadena, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 806-13(Apr. 1963).

Several critical problems which arise from the adaptation of a modified Penning-type arc to plasma propulsion, are examined. The use of a cold cathode discharge using an alkali metal fuel is considered as an attractive alternative to thermionic discharges, particularly where plasma exhaust velocites are characterized by $2000 < I_{sp} < 4000$ sec. Analyses show that the cathode losses are dependent upon the probability of ionization, secondary electron yield, sputtering, and exhaust efficiency. Particular emphasis was placed upon the problem of ejecting the exhaust plasma that is formed in the arc, first through a divergent solenoidal magnetic field and then into free space. Experimental evidence, using a special cold-cathode plasma generator, has confirmed the calculations of the critical problems to an order of magnitude. Both experimentally and theoretically, within the limits of the modified Penning plasma generator, the results indicate that at present it is inefficient for propulsion and that there is an especially important associated problem of plasma ejection through the magnetic gradient exhaust region. (auth)

24078 SOME PHYSICAL INTERPRETATIONS OF MAGNETOHYDRODYNAMIC DUCT FLOWS. Fujihiko Sakao (Tokyo Univ.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 915-16(Apr. 1963)

Physical interpretations of magnetohydrodynamic duct flows with various boundary conditions for effects of conducting walls on the pattern of electric current are presented for rectangular ducts. The current patterns are illustrated for rectangular ducts having various combinations of conducting and nonconducting walls with a uniform magnetic field applied in the horizontal direction. (C.E.S.)

24079 OPTIMIZATION OF A RADIATION-COOLED THERMIONIC CONVERTER. Edwin Blue and John H. Ingold (General Electric Co., Pleasanton, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 1155-9(May 1963).

The electrical power output of a radiation-cooled thermionic converter with a fixed radiator area is maximized with respect to the anode work function and to the ratio of cathode area to radiator area. The results show that, at high cathode temperature, it is important to cool the anode at the expense of power-generating area, whereas at low cathode temperature, the reverse is true. In addition, the results show that, at high cathode temperature, the optimum anode work function and temperature are equal to about 75% of the corresponding cathode work function and temperature. (auth)

24080 ATOMIC ABSORPTION STUDIES USING A HOLLOW-CATHODE TUBE AS AN ABSORPTION SOURCE. Joseph A. Goleb and James K. Brody (Argonne National Lab., Ill.). Anal. Chim. Acta, 28: 457-66(May 1963). (In English)

When hollow-cathode tubes are used as the emission

source and as the absorption source, atomic absorption studies reveal microgram quantities of several elements; Na, Mg, Ca, Be, and Si were detected in the discharge of the absorption tube. Conventional, independent circulating systems and dc power supplies were used with each tube, along with other readily available equipment. An analytical curve plotted for Na over the range 0 to 100 μg, obeys Beer's law. Lithium and Mg suppress the Na absorption values; thus careful standardization is necessary. The average percent deviation from the mean for a number of Na samples analyzed was ±8.0%. (auth)

24081 LORENTZ'S PENDULUM PROBLEM. J. E. Littlewood (Trinity Coll., Cambridge, Eng.). Ann. Phys. (N. Y.), 21: 233-42(Feb. 1963).

The behavior of a simple pendulum is derived for the case in which the suspending thread is gradually shortened. (C.E.S.)

24082 STUDIES OF POLARON MOTION. PART III. THE HALL MOBILITY OF THE SMALL POLARON. L. Friedman and T. Holstein (Univ. of Pittsburgh). Ann. Phys. (N. Y.), 21: 494-549(Mar. 1963).

The one-dimensional molecular crystal model of polaron motion, previously developed, is suitably generalized to consider the existence of a Hall effect. The treatment is confined to the case for which the electronic-overlap term of the total Hamiltonian is a small perturbation. In zeroth order — i.e., in the absence of this term — the electron is localized at a given site. The vibrational state of the system is specified by a set of quantum numbers, N_k, giving the degree of excitation of each vibrational mode. The existence of a nonvanishing electronic bandwidth then gives rise to transitions to neighboring sites. Of principal interest is the high temperature regime ($T > T_t$), where polaron motion is predominant by means of random jumps between neighboring sites. Although the lowest order jump rate is adequate in considering the polaron drift mobility, higher order processes, involving the occupation of (at least) three sites, must be taken into account in treating the Hall effect. In particular, it is demonstrated that the relative probability of the electron, initially located on one of the three sites, hopping to one or the other of the remaining two sites, is modified by a contribution which, both in sign and magnitude, is linearly proportional to the applied magnetic field. This effect is shown to arise from the interference between the amplitude for the direct transition from the initial to the final site, and the amplitude for an indirect, second order transition, involving intermediate occupancy of the third site. The (magnetic) field induced components of the jump rates, corresponding to the above processes, are first calculated by a classical occurrence-probability approach which treats the lattice vibrational coordinates as given functions of time. The second approach presents a full quantum mechanical calculation of the jump rates. The results of this treatment agree with those of the occurrence-probability approach in the classical limit ($T \gg \Theta_{Debye}$). The order of magnitude of the calculated Hall Coefficients is found to be greater than or comparable to the "normal" result ($R = -1/nec$) depending on whether or not the three sites involved in the transition are mutually nearest neighbors. A final note corrects an error in a previous paper by one of the authors (T. H.) concerning the sign of the Hall effect in impurity conduction. (auth)

24083 CONTINUATION AND OPTIMIZATION OF THE BORN EXPANSION IN NONRELATIVISTIC QUANTUM THEORY. Manuel Rotenberg (Univ. of California, San Diego). Ann. Phys. (N. Y.), 21: 579-92(Mar. 1963).

Methods of von Neumann, Lanczos, and others are applied to the non-relativistic scattering problem. It is shown that if the Born series is modified suitably, it will converge for almost any strength of interaction. Further, if suitable linear combinations of the modified Born approximations are used in the usual iteration process, the rate of convergence can be improved. The methods also apply to systems of integral equations that describe scattering of a particle from a complex system. (auth)

24084 FLAT-SPACE METRIC IN GENERAL RELATIVITY THEORY. Nathan Rosen (Israel Inst. of Tech., Haifa). Ann. Phys. (N. Y.), 22: 1-11(Apr. 1963).

The main points in the formalism involving a flat-space metric tensor $\gamma_{\mu\nu}$ together with the Riemannian metric tensor $g_{\mu\nu}$ are summarized and discussed. The advantages of this formalism in distinguishing between an inertial field and a permanent gravitational field and in providing an energy-momentum density tensor for the latter are pointed out. Many different field equations are possible, but an invariance principle is proposed that essentially singles out the Einstein field equations. (auth)

24085 CURRENT CAPACITY OF A SUPERCONDUCTOR OF THE SECOND KIND. J. W. Heaton and A. C. Rose-Innes (Services Electronics Research Lab., Baldock, Herts, Eng.). Appl. Phys. Letters, 2: 196-7(May 15, 1963).

Wires of Ta-55 at. % Nb alloy containing numerous dislocations were subjected to magnetization measurements at 4.2°K. The critical currents had the typical characteristics of a high-field superconductor with a plateau of high critical current extending to about 3500 oersteds. After annealing for 25 hr in a high vacuum at ~1500°C, magnetization measurements showed that these annealed wires behaved almost like perfect superconductors of the second kind, with very little hysteresis and no detectable trapped flux. The high-field current capacity is nearly zero and the critical currents in high magnetic fields are two orders of magnitude less for the annealed wires than for the original wires. (C.E.S.)

24086 ELECTRODE SPUTTERING IN HIGH PRESSURE ELECTRIC DISCHARGES. J. M. Feldman and E. M. Williams (Carnegie Inst. of Tech., Pittsburgh). Appl. Sci. Res., Sect. B, 10: 7-22(1963). (In English)

It is shown from considerations of empirical data that sputtering could play a significant role in the erosion of certain cathode materials subjected to high pressure electric discharges. Several characteristics of low energy sputtering and high pressure discharges are inferred from these results. An experimental verification of the arc process postulated herein is presented. (auth)

24087 EIGENVALUES AND EIGENFUNCTIONS OF THE LINEARIZED BOLTZMANN COLLISION OPERATOR FOR A MAXWELL GAS AND FOR A GAS OF RIGID SPHERES. Z. Alterman, K. Frankowski, and C. L. Pekeris (Weizmann Inst., Rehovoth, Israel). Astrophys. J., 7: Suppl. Ser., 69, 291-332(Nov. 1962).

Transport phenomena in rarefied gases are treated by the method of expansion in the eigenfunctions of the linearized Boltzmann collision operator. The eigenvalues for a Maxwell gas, and the collision eigenvalues and eigenfunctions for a rigid-sphere gas are evaluated. (auth)

24088 SIMULATION OF EXTENDED γ RADIATION SOURCES. V. I. Popov. At. Energ. (USSR), 14: 219-20 (Feb. 1963). (In Russian)

The simulation method was used for studying the effect of self-absorption and multiple scattering on the γ-radiation

yield. A cylindrical Plexiglas container filled with a Co^{60} sulfate solution was immersed in a larger, water-filled cylinder and the whole system placed on a turntable. The dose rate was measured by means of a 200-cm^3 ionization chamber with air-equivalent walls. Results of the measured dose rates from the true and the simulated cylindrical sources agreed well with each other. The effect of self-absorption and multiple scattering was determined by making measurements in the base plane of the cylinder with and without water in the system. The effect of the distance on the attenuation factor was obtained from measurements made with the water at various heights in the cylinder. It was found that at large relative heights, an increase of the distance results in an increase of the attenuation factor; using small relative heights, an opposite effect was obtained. Similar results were obtained concerning the self-absorption. Keeping the height of water constant, the attenuation factor increased with the decreasing radius of the cylindrical source. (TTT)

24089 THE SOLUTION OF THE BOLTZMANN EQUATION FOR A SHOCK WAVE WITH THE HELP OF THE BURNETT STATEMENT FOR THE DISTRIBUTION FUNCTION. W. Barthold (Universität, Kiel). Atomkernenergie, 8: 132-7(Apr. 1963). (In German)

The Boltzmann equation was solved by an iterative method using the Burnett approach for the distribution function in the first, second, and third order. The results are the courses of temperature and speed in the shock front. The shock front thicknesses were determined. They were compared to one another, to the Becker solution, and to measurement values by Talbot, Sherman, and Hornig. It was found that the solution method leads to a divergent behavior. With increasing order, the number of singularities in the differential equation system increased. The solution of the first order gave results agreeing best with the measured shock front thicknesses. There were solutions for any given pressure conditions. In the solutions of higher orders, their variety was increasingly limited. In these cases solutions were available only for small pressure conditions. (auth)

24090 THE DRIFT VELOCITY OF ELECTRONS IN HYDROGEN AND NITROGEN. J. J. Lowke (Australian National Univ., Canberra). Australian J. Phys., 16: 115-35(Mar. 1963).

Experimental results are given for the drift velocity of electrons in hydrogen and nitrogen at 293 and 77.6°K over the range $0.001 \leq E/p \leq 20$ v cm^{-1} $mmHg^{-1}$. The results were obtained using the method of Bradbury and Nielsen and have in general an accuracy of 1% at 293°K and 2% at 77.6°K. The measurements were made over as wide a range of gas pressures as possible for each value of E/p and all results are presented in tabular form. In the final results corrections were made for errors due to diffusion. Experiments are also discussed that were designed to investigate the extent of the existence of errors due to factors such as distortion of the d-c field from voltages on the shutter wires and the presence of gaseous impurities. It was shown that measurements of the drift velocity are particularly sensitive to traces of water vapor as impurity. (auth)

24091 MATHEMATICAL STRUCTURE OF WIGHTMAN FORMULATION OF QUANTUM FIELD THEORY. K. Maurin (Inst. of Mathematics, Polish Academy of Sciences, [Warsaw]). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 11: 115-19(1963). (In English)

Some theorems of the type Borchers used in his mathematically correct formulation of Wightman's classic construction of quantum field theory are shown to be of rather general validity. The mathematical structure consisting of the triplet (Φ,G,W) permits construction of a nuclear space, a separable Hilbert space H, unitary representation U of the group G in H, and a cyclic representation of the nuclear algebra Φ. The functional W is represented as an integral $S_z W_\xi \, d\mu$, where W_ξ have all the properties of the functional W and lead to irreducible representation A_ξ of the Φ algebra in a Hilbert space H_ξ. Several models of the triplet that are of importance for the quantum field theory are given. (auth)

24092 ON SOME THEOREMS OF H. J. BORCHERS. K. Maurin (Inst. of Mathematics, Polish Academy of Sciences, [Warsaw]). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 11: 121-3(1963). (In English)

Specialization of the triplet (Φ,G,W) used by Borchers in formulating the Wightman construction of relativistic quantum field theory is shown to yield important theorems of Borchers. (D.C.W.)

24093 THE SIZE EFFECT OF FREE ELECTRON GAS. K. F. Wojciechowski (Univ. of Wroclaw, Poland). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 11: 125-9(1963). (In English)

An expression relating the Fermi energy with the electron density and sample dimension is derived. The expression shows that the Fermi energy of free electrons increases with the decrease of the smallest dimension of the metallic sample. The relation of the electronic specific heat γ, the paramagnetic susceptibility χ, and the work function φ to the Fermi energy is considered, and the size of the metallic sample is noted to influence the density of electronic states. (D.C.W.)

24094 GAUGE-INVARIANT VARIABLES IN THE YANG-MILLS THEORY. I. Bialynicki-Birula (Univ. of Warsaw). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 11: 135-8(1963). (In English)

Using Mandelstam's ideas, the gauge-independent field variables in the Yang-Mills theory are explicitly constructed. The field equations obeyed by these fields are linear and coincide with field equations in electrodynamics. The possibility of using gauge-independent fields to quantize the Yang-Mills theory and to construct coordinate-independent variables in general relativity is suggested. (auth)

24095 EQUATION OF MOTION AND RADIATION DAMPING FOR A RELATIVISTIC CHARGED PARTICLE. F. Henin (Université Libre, Brussels). Bull. Classe Sci. Acad. Roy. Belg., (5), 48: 884-902(1962). (In English)

A relativistic generalization of the Sommerfeld extended electron theory was recently published (Physica, 28: 667 (1962)). The equation of motion that was obtained is studied in the case of one-dimensional motion. The elimination of nonphysical solutions from the Lorentz-Dirac equation and the existence of self-oscillating solutions are discussed. The energy emitted by the particle exposed to the action of an external oscillating field of low amplitude was calculated as a function of the frequency and the results are compared with those of the Lorentz-Dirac theory and the Peierls-McManus nonlocal theory. The differences among the three theories appear clearly at large frequencies, and they are connected to different hypotheses on the structure of the particle. The effect of nonlinear terms of the equation of motion of the present theory is studied in the case of a constant external force. These terms lead to the introduction of an effective mass dependent on the acceleration. (tr-auth)

24096 POLARONS. J. Devreese (CEN, Mol, Belg.). Bull. Soc. Belge Phys., Ser. III, No. 3, 19p.(Dec. 1962). (BLG-166). (In Dutch)

The theory of the behavior of slow electrons in a polar crystal is reviewed. First the adiabatic approximation is treated on classical and also on quantum mechanical grounds. The field theoretical treatment is given with the aid of the Tomonaga approximation. The results of the investigation of this problem with the aid of the "path-integral" formalism are mentioned. The applicability of the various approaches is discussed for different values of the coupling constant. A comparison is made between the different theories. (auth)

24097 VIBRATIONAL RELAXATION IN DISSOCIATING DIATOMIC GASES. M. McChesney (Univ. of Liverpool). Can. J. Phys., 41: 717-23(May 1963).

The available theoretical analyses relating to the vibrational excitation of a dissociating gas that assume that the gas dissociates from vibrational level populations given by the Maxwell–Boltzmann distribution law are questioned. The two theories of thermal dissociation are briefly outlined and it is shown that either theory gives non-equilibrium-level populations. Furthermore, the use of a simple relaxation equation to describe the vibrational excitation of anharmonic oscillators in high vibrational levels is questioned. (auth)

24098 OBSERVATION OF THE FREE SURFACE OF LIQUID HELIUM II IN ROTATION. R. R. Turkington, J. B. Brown, and D. V. Osborne (Univ. of British Columbia, Vancouver). Can. J. Phys., 41: 820-3(May 1963).

The free surface of liquid helium II in rotation was measured at angular velocities lower than 3.1 rad sec^{-1} to permit direct comparison with previous mechanical experiments. Observation of the free surface has the advantage that it measures directly the mean square velocity of the liquid as a function of radius. Parallel monochromatic light fell obliquely on the free surface, and the reflected beam formed two perpendicular astigmatic line images. For most speeds of rotation, one or both images were observable, enabling the effective curvature of the helium surface to be calculated. It is concluded that the superfluid rotates on the average with the normal fluid for the angular velocities used. (C.E.S.)

24099 REVERSIBLE ADSORPTION OF HELIUM AT LIQUID NITROGEN TEMPERATURE IN AN IONIZATION GAUGE. J. P. Hobson and T. Edmonds (National Research Council, Ottawa). Can. J. Phys., 41: 827-8(May 1963). (NRC-7380)

It was previously demonstrated that for helium ions striking molybdenum, the capture probability increases and the re-emission probability decreases as the surface temperature is lowered from 330 to 77°K. A new property of this experiment is presented. The additional gas pumped by the cooled glass walls of an operating ionization gauge is spontaneously desorbed when the wall temperature is raised once again to its original value. The same qualitative result was found with neon. (C.E.S.)

24100 THERMIONIC NUCLEAR REACTORS. E. P. Gyftopoulos and G. N. Hatsopoulos (Massachusetts Inst. of Tech., Cambridge). IEEE (Inst. Elec. Electron. Engrs.) Trans. Commun. Electron., No. 65, 98-115(Mar. 1963).

The coupling of nuclear reactors with thermionic converters is reviewed. First, operation of thermionic converters are discussed together with present and anticipated advancements. Particular emphasis is given to parameters that influence optimum performance and life of converters; namely, work function of emitter and collector, spacing between the same, temperatures of operation, cesium vapor pressure, and materials. The discussion is illustrated by a series of experimental results and amplified by theoretical analysis. Next, three conceptual designs of thermionic nuclear reactors are reviewed and presented as reference points to establish performance characteristics and materials requirements, as well as problem areas that result from the marriage of nuclear reactors and thermionic converters. Chief conclusions are: (1) The most efficient way of coupling thermionic converters with a reactor is by dispersing the former throughout the volume of the nuclear core, and (2) thermionic nuclear reactors have several unique features for space, submarine propulsion, and applications in remote areas. (auth)

24101 IONIZATION DISTRIBUTION IN WATER IRRADIATED WITH FAST ELECTRONS. E. H. Cornish (Standard Telecommunication Labs. Ltd., Harlow, Essex, Eng.). Intern. J. Appl. Radiation Isotopes, 14: 81-6(Feb. 1963). (In English)

The use of glass as a radiation indicator is described, with emphasis on methods of calibrating the brown coloration produced against the electron dose received. Such indicators, in the form of soda glass microscope slides, were used to estimate the distribution in depth of ionization in water irradiated with electrons over the energy range 1.43 to 2.00 Mev. Similar results were obtained with ice at temperatures as low as −195°C, and it was shown that ionization distribution was similar to that previously reported for water and light metals, but increased backscattering was evident when water was converted to ice. This increase was more probably due to the change of state rather than to increases of density. (auth)

24102 THE USE OF SECONDARY ELECTRON EMISSION IN PHOTOGRAPHIC FILM DOSIMETRY. G. K. Schweitzer and E. A. Lloyd (Univ. of Tennessee, Knoxville). Intern. J. Appl. Radiation Isotopes, 14: 87-95(Feb. 1963). (In English)

The characteristics of secondary electrons emitted by various thicknesses of different metals when irradiated at a number of photon energies ranging from 35 to 1250 kev were investigated. The photographic effect produced by a given dosage was increased by a factor of 3 or more when the secondary electrons from the metal were allowed to reach the film. A film badge designed to utilize this phenomenon should be a considerable improvement over those in current use. (auth)

24103 THE THEORY OF TAPERING SPARK DISCHARGER. G. A. Mesyats (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 137-41(1963). (In Russian)

Descriptions are given of a tapering spark discharger for developing pulses with decades of kilovolts and 10^{-10} to 10^{-9} sec leading pulses. Following a series of experiments, the leading pulses were reduced from 0.8×10^{-6} to 10^{-9} sec. The results indicated that an optimum taper length and stability with minimum pulse duration can be found for a given pulse amplitude. In order to reduce the output pulse duration it is necessary to reduce the incoming pulse duration. A consequent switching of tapering discharges can reduce the leading pulse from 10^{-6} to 10^{-9} sec and less. (R.V.J.)

24104 INERT-GAS CLEAN-UP IN THE HOT-CATHODE DISCHARGE. R. F. Hall (Mullard Research Labs., Salfords, Surrey, Eng.). J. Electron. Control (1), 11: 101-9(Aug. 1961). (In English)

Inert-gas clean-up in hot-cathode discharge tubes is almost invariably associated with sputtering (except in

the case of helium) and, until recently, the connection between them has not been clarified. The results of the experimental investigation described show that the rate of gas clean-up depends markedly on the rate of build-up of sputtered deposits on surfaces adjacent to the discharge. The rate at which an electrode is sputtered is found to depend on the plasma density gradient in its vicinity which in turn may depend on the discharge mode. Some ways of avoiding high clean-up rates due to excessive sputtering are suggested. (auth)

24105 CYCLOTRON WAVE INTERACTION IN SPATIALLY PERIODIC ELECTROSTATIC QUADRUPOLE FIELDS. J. C. Bass and M. G. F. Wilson (Associated Electrical Industries, Aldermaston, Berks, Eng.). J. Electron. Control (1), 11: 125-44(Aug. 1961). (In English)

The small signal theory of transverse interaction of cyclotron waves on filamentary electron beams with spatially periodic fields is discussed with particular reference to the electrostatic quadrupole amplifier. Both a ballistic and a cyclotron wave theory are given and the results shown to provide two complementary descriptions of the interaction process. Gain expressions are derived for the amplification process, and the case of non-optimum pumping is discussed. Periodic energy interchange between waves without amplification is also discussed. The case of a synchronous wave input to the amplifying structure is treated and the results applied to the transverse spread of thick beams which takes place in quadrupole structures. The theories described can be applied more generally to interaction with other spatially periodic structures. (auth)

24106 A NOTE ON ANOMALOUS RADIAL VELOCITY SPECTRA FROM ROUGH THERMIONIC EMITTERS. Hilary Moss (Westinghouse Electric Corp., Elmira, N. Y.). J. Electron. Control (1), 11: 289-95(Oct. 1961).

A simple pinhole spectrometer is used to estimate the radial emission velocities of electrons from some typical planar cathodes. It is fairly conclusively shown that rough cathodes can yield high apparent radial velocities (order of 10 to 20 volts) under temperature limited conditions. These anomalous values disappear when the cathodes are physically smoothed or are operated under space charge limited conditions. A simple theory explains the findings. (auth)

24107 ELECTRON ORBITS THROUGH A QUADRIPOLE AMPLIFYING STRUCTURE. H. W. Tuffill and A. D. Williams (General Electric Co. Ltd., Wembley, Eng. and Hirst Research Centre, Wembley, Eng.). J. Electron. Control (1), 11: 401-23(Dec. 1961). (In English)

Results are described of some calculations which were performed to determine the trajectories of electrons while traversing the amplifying structure of a quadripole amplifier. These calculations were based on the equations of motion of the electrons while traversing the amplifying structure. Although particular physical dimensions and frequencies were used for the calculations, the results obtained are seen to be of more general application than just these particular physical dimensions and frequencies. It is shown that when a beam of finite cross section is considered the pump fields induce transverse motions in the beam, even in the absence of signal orbits, producing a larger beam diameter as the beam traverses the amplifying structure. This expansion is greater than that due to the signal orbits and sets a limit to the gain that can be achieved before the onset of interception. Similar results are obtained for the Ashkin-type structure in which the quadripole is replaced by an equivalent two pole, and it is shown that the induced motions produce more serious problems in this case. Lengthening the amplifying structure, and using a proportionately smaller pump field to produce the same gain, reduces these effects. The induced motions are less pronounced at high operating frequencies, if the length of the amplifying structure is the same. From the results an attempt is made to define the maximum permissible value of the gain per cyclotron wavelength, when the signal is being amplified in an Ashkin-type structure. This value is shown to be less than 2 db per cyclotron wavelength using the results obtained at particular operating frequencies. Below this value there is a variation in the x-coordinate of the electron of less than 15%, when there is 10 db overall gain. Although particular frequencies are used, the results obtained at 500 Mc and 1400 Mc suggest that this result is independent of frequency. (auth)

24108 EXPERIMENTS IN A CYLINDRICAL MAGNETIC SHOCK TUBE. G. C. Vlases (California Inst. of Tech., Pasadena). J. Fluid Mech., 16: 82-96(May 1963).

Experiments were carried out in a cylindrical magnetic shock tube on the propagation of a shock wave into a fluid containing a uniform transverse magnetic field. Cylindrical shock waves in the Mach number range from 20 to 100 were produced that are very stable and reproducible. Theory predicts basic differences between the case where the gas is initially highly conducting and the case where a gas-ionizing shock propagates into a cold gas. Good agreement between theory and experiment was obtained for the gas ionizing shocks. (auth)

24109 THE CONDUCTIVITY OF A PARTIALLY IONIZED GAS IN ALTERNATING ELECTRIC FIELDS. J. P. Dougherty (Cambridge Univ., Eng.). J. Fluid Mech., 16: 126-37(May 1963).

A conductivity tensor is calculated for a partially ionized gas subject to electric fields that are harmonic in space and time, and to a uniform magnetic field. The collisions between charged particles and neutral molecules are included in the theory in an approximate way by means of a simplified form of Boltzmann's equation. A simplified expression for the longitudinal component of the tensor is derived. Some applications of the results are mentioned. (auth)

24110 THE ASSOCIATION OF PLANE-WAVE ELECTRON-DENSITY IRREGULARITIES WITH THE EQUATORIAL ELECTROJET. Robert Cohen and Kenneth L. Bowles (Jicamarca Radar Observatory, Lima). J. Geophys. Res., 68: 2503-25(May 1, 1963).

It is demonstrated that the (plane-wave electron-density) irregularities (of the ionosphere) are spatially and temporally correlated with the equatorial electrojet. First, it is shown experimentally that the irregularities occur in the height and latitude region in which the electrojet flows; i.e., they are embedded in the electrojet. Second, it is shown that there are temporal correlations between the intensity of the radio waves scattered from the irregularities associated with the electrojet and the horizontal intensity of the earth's magnetic field, a measure of the electrojet current. The scattered intensity is imperceptible until a certain threshold of electrojet current is reached. As the electrojet current increases above the threshold, a scatter signal suddenly rises above the noise, increasing abruptly at first, then gradually. This threshold suggests that the plasma wave irregularities are generated by the current stream. According to the theory of Farley such a threshold can be interpreted as the onset of a plasma instability in the equatorial electrojet, leading to the formation of plasma waves. It is shown that by means of the intensity of the signal scattered from the electrojet ir-

regularities, together with magnetometer measurements, it may be possible to estimate from ground observations the daytime field variation resulting from disturbance currents at great distances from the earth. (auth)

24111 PRELIMINARY REPORT ON RECENT MEASUREMENTS TO DETERMINE THE WIDTH OF THE EQUATORIAL SPORADIC-E LAYER. R. W. H. Wright and F. Hibberd (Univ. of Ghana, Legon). J. Geophys. Res., 68: 2527-8(May 1, 1963).

Ionograms are presented that indicate a consistent belt of half-width 3° magnetic latitude having 100% occurrence of equatorial sporadic E reflection from the ionosphere between the hours 0830 and 1330 GMT. Symmetry suggests that the belt is 600 km wide with a length of approximately 75° of longitude. (C.E.S.)

24112 THE EFFECT OF THE MAGNETIC DECLINATION ON THE F_2 LAYER. R. W. Eyfrig (Deutsche Bundespost, Breisach, Ger.). J. Geophys. Res., 68: 2529-30(May 1, 1963).

It is shown that the critical frequency of the F_2 ionospheric layer varies with magnetic declination. Evidence is also presented that the effect is much smaller for stations of western declination than for stations of eastern declination. (C.E.S.)

24113 DIFFUSION OF IONIZATION IN A DIPOLE FIELD. A. J. Lyon (University Coll., Ibadan, Nigeria). J. Geophys. Res., 68: 2531-40(May 1, 1963).

An equation is derived for the rate of ambipolar diffusion of ionization along lines of force in a dipole field; its significance is discussed, especially in relation to the magnitude and effects of horizontal outward diffusion in the ionosphere near the magnetic equator. At great heights the variation of electron density with reduced height z approximates at all latitudes to $e^{-\frac{1}{2}z}$. Upward electrodynamic drift at the equator can probably lead to a substantial reduction of peak electron density, owing to increased outward diffusion, as envisaged in the fountain theory, but only if the drift velocity is large in relation to the ambient recombinative loss rate. (auth)

24114 SOME CHARACTERISTIC FEATURES OF THE EQUATORIAL IONOSPHERE AND THE LOCATION OF THE F-REGION EQUATOR. B. C. Narasinga Rao (National Physical Lab., New Delhi, India). J. Geophys. Res., 68: 2541-9(May 1, 1963).

The characteristic features of the equatorial F region are studied using the published ionospheric data. The study reveals some important differences in the Asian, African, and American zones. In the diurnal variation of F_2-region critical frequencies there are two peaks, one in the forenoon and the other in the afternoon, in the Asian zone, whereas the afternoon peak is absent in the American zone during sunspot maximum. The width of the equatorial trough is smaller in the American than in the Asian zone. The location of the F-region equator is examined; the results indicate that the F-region equator does not correspond exactly to the magnetic dip equator but is shifted slightly toward the north in the Asian and American zones and slightly toward the south in the African zone. (auth)

24115 THE POSTSUNSET RISE OF f_0F_2 IN THE TRANSITION REGION AND ITS DEPENDENCE ON THE POSTSUNSET RISE OF h'F IN THE EQUATORIAL REGION. B. C. Narasinga Rao (National Physical Lab., New Delhi, India). J. Geophys. Res., 68: 2551-7(May 1, 1963).

In the transition region lying between the equatorial anomaly region and the middle latitudes a characteristic postsunset rise in F_2-region critical frequencies is observed during years of high sunspot activity. This phenomenon is found to depend on the evening height rise in the equatorial region. The analysis presented substantiates the view that the ionization lifted over the equatorial region is transported along the magnetic lines of force to the transition region. (auth)

24116 DIFFUSION IN THE EQUATORIAL F LAYER. H. Rishbeth, A. J. Lyon, and Margaret Peart (Dept. of Scientific and Industrial Research, Ditton Park, Slough, Bucks, Eng.). J. Geophys. Res., 68: 2559-69(May 1, 1963).

The theoretical form of the ionospheric F layer near the magnetic equator is discussed for conditions of equilibrium. A digital computer is used to solve an equation that includes photoionization, loss, and the diffusion of ionization along geomagnetic field lines, thus enabling electron densities to be computed as a function of latitude and height. A small equatorial trough is found in the peak electron density, but this is much smaller than the well-known Appleton anomaly of the actual F layer. Below the peak, the ionization is approximately in photochemical equilibrium; the shape of the layer above the peak corresponds approximately to diffusive equilibrium. (auth)

24117 SOME MEASUREMENTS ON THE SUNSET FADING EFFECT. J. R. Koster (Univ. of Ghana, Legon). J. Geophys. Res., 68: 2571-8(May 1, 1963).

The sunset fading effect, or flutter fading, is a phenomenon sometimes observed on radio signals reflected from the F region of the ionosphere when the reflection point is near the magnetic equator. The effect was investigated in Ghana using direct observation of the carrier level, a fading-rate meter, and the Doppler fading technique. It is found that flutter fading occurs between sunset and midnight, has equinoctial maximums, and correlates positively with the sunspot cycle. The fading rate is directly proportional to the frequency. It is suggested that coherent scatter from elongated irregularities could account for the observed correlation with radio-star scintillations and for the Doppler fading results. (auth)

24118 INSTABILITY OF THE EQUATORIAL F LAYER AFTER SUNSET. Wynne Calvert (Montana State Coll., Bozeman and National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 68: 2591-3(May 1, 1963).

It is shown that the downward wind caused by the cooling of the upper atmosphere after sunset could give rise to the irregularities in the equatorial F region observed at that time. The observed cooling appears to provide the same degree of instability as that provided by electric fields on Martyn's theory. (auth)

24119 LYMAN α SCATTERING IN THE EARTH'S HYDROGEN GEOCORONA. [PART] I. G. E. Thomas (Univ. of Pittsburgh). J. Geophys. Res., 68: 2639-60 (May 1, 1963).

The interpretation that the nighttime Lyman α observed from rockets is solar Lyman α that was transported to the night side by the earth's extensive hydrogen envelope (the geocorona) is considered in detail. The equations of radiation transfer are solved for several spherically symmetric models of the hydrogen distribution. The numerical results for the integrated Lyman α night glow are compared with the observations. Radiation transfer in models whose total hydrogen abundance is consistent with daytime absorption measurements is shown to be inadequate in accounting for the observed night flow features. (auth)

24120 LYMAN α SCATTERING IN THE EARTH'S HYDROGEN GEOCORONA. [PART] II. T. M. Donahue

and G. E. Thomas (Univ. of Pittsburgh). J. Geophys. Res., 68: 2661-7(May 1, 1963).

Analysis of experiments bearing on Lyman α excitation in the night flow leaves two possible explanations. One is a combination of direct scattering in a distant hydrogen cloud following the earth and multiple scattering in the thermosphere and exosphere. There is a difficulty accounting for the presence of the hydrogen cloud or geocorona. The other explanation is that during the night the thermosphere and exosphere contain 4 to 5 times as much hydrogen per unit column above 120 km as during the day. Although considerably more hydrogen is expected at night because of the much lower temperature, it is questionable whether a large enough change can occur in half a day. (auth)

24121 GEOMAGNETIC EFFECTS ON THE FREQUENCY SPECTRUM OF INCOHERENT BACKSCATTER OBSERVED AT 425 MEGACYCLES PER SECOND AT TRINIDAD. V. C. Pineo (Massachusetts Inst. of Tech., Lexington), D. P. Hynek, and G. H. Millman. J. Geophys. Res., 68: 2695-2706(May 1, 1963).

Spectral characteristics of radar signals backscattered incoherently from the ionosphere were measured during January and February 1961 at Trinidad, West Indies. This location allows the observation of signals returned from the F region at normal incidence to the geomagnetic field. Spectrums measured at angles of incidence greater than about one degree were nearly flat topped with weak maximums about ±3.5 kc/s relative to the center frequency. Spectra measured at normal incidence to the field have a single peak at the center frequency and are narrower than the off-normal spectra. A comparison of a normal-incidence spectrum with an off-normal spectrum indicates that the total scattered power is not affected by the field. The observed change in the shape of the spectra as the radar beam approaches orthogonality to the field is in agreement with theoretical predictions and suggests the use of the incoherent backscatter technique to obtain magnetic field elements at great heights above the earth. (auth)

24122 CHARACTERISTICS OF SPREAD F AT HIGH GEOMAGNETIC LATITUDE. W. K. Klemperer (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 68: 3191-6(May 15, 1963).

A detailed analysis of the fading observed during spread F at Ithaca, New York (74° dip), shows that steady components are present at all ranges within the echo proper. Accordingly, it seems unlikely that theories relying on random scattering processes can properly explain the pronounced spread in range observed. To investigate the mechanism responsible for spread F, a lobe-swept interferometer was designed to estimate the width of the angular spectrum of radio waves reflected from the ionosphere under spread-F conditions. This instrument was operated at spacings from $5\frac{1}{2}$ to $12\frac{1}{2}$ wavelengths. Data obtained with it indicate that the type of spread F observed at high geomagnetic latitudes has a narrow angular spectrum. These observations are in substantial agreement with recent theories that attribute long delay times to the guiding action of field-aligned irregularities within the F layer. The correlation of spread F with strong scintillation of the radio source Cygnus A at upper culmination is found to exceed 0.8. The height of the irregularities responsible for radio-star scintillation is not known accurately; there are indications, however, that the irregularities lie above the F-layer maximum, and it is tempting to imagine them extending right through the F region on nights of spread-F activity. (auth)

24123 COLLISIONS BETWEEN He^+ AND O_2. W. L. Fite, A. C. H. Smith, R. F. Stebbings, and J. A. Rutherford (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Geophys. Res., 68: 3225-9(May 15, 1963).

Two laboratory experiments were performed to study the products of collisions between He^+ and O_2. In the first, mass spectrometry of afterglows in mixtures of helium and oxygen indicated that the product of the collisions at thermal energies was O^+, with a rate coefficient of the order of 5×10^{-10} cm^3 sec^{-1}. In the second, higher-energy crossed-beam techniques indicated again that the reaction yielded O^+. In the energy range 0.1 to 2.0 kev, the energy dependence and magnitude of the reaction cross section were such as to suggest that the collision process is an accidentally resonant, dissociative charge transfer. (auth)

24124 DAMPING OF MAGNETOSPHERIC MOTIONS BY THE IONOSPHERE. K. D. Cole (Dept. of External Affairs, Melbourne). J. Geophys. Res., 68: 3231-5(May 15, 1963).

Motion in the magnetosphere described by $E + v \times B = 0$, though implying no dissipation in the magnetosphere, persists only by the doing of significant amounts of work in the ionosphere. The time constant for the decay of such motion, when the ionosphere is initially at rest, varies from <0.1 sec at low magnetic latitudes to <10 sec at middle latitudes. (auth)

24125 THE CALCULATION OF ELECTRON DENSITY PROFILES FROM TOPSIDE SOUNDER RECORDS. J. O. Thomas (Cambridge Univ., Eng.), A. R. Long, and D. Westover. J. Geophys. Res., 68: 3237-42(May 15, 1963).

An ionosonde in a vehicle immersed in the plasma above the peak of the F_2 layer of the ionosphere measures, as a function of frequency f, the virtual depth h' below the vehicle at which radio waves are reflected from the topside of the ionosphere. A method is presented for converting the observed topside $h'(f)$ curves into electron density profiles. (auth)

24126 LONG-PERIOD PULSATIONS IN ELECTRON PRECIPITATION ASSOCIATED WITH HYDROMAGNETIC WAVES IN THE AURORAL ZONE. C. D. Anger, J. R. Barcus, R. R. Brown, and D. S. Evans (Univ. of California, Berkeley). J. Geophys. Res., 68: 3306-10(May 15, 1963).

A number of x-ray observations during an auroral storm indicate that electron precipitation on the auroral zone accompanies geomagnetic disturbances of a hydromagnetic nature transmitted through the geomagnetic field as well as disturbances of a local origin resulting from current systems at ionospheric levels. (C.E.S.)

24127 DISCUSSION OF OUR EARLIER PAPER "HYDROMAGNETIC INTERPRETATION OF SUDDEN COMMENCEMENTS OF MAGNETIC STORMS." Charles R. Wilson (Geophysical Inst., College, Alaska) and Masahisa Sugiura. J. Geophys. Res., 68: 3314-22(May 15, 1963).

The polarization rules of elliptically polarized hydromagnetic waves in magnetic storm sudden commencements are presented. (C.E.S.)

24128 SYMMETRY IN QUANTUM THEORY. Gerard Emch (Université, Geneva) and Constantin Piron. J. Math. Phys. (N. Y.), 4: 469-73(Apr. 1963).

A precise definition of symmetry in quantum theory is given in order to generalize Wigner's representation theorem, in the framework of lattice theory and projective geometry. The concept of physical state is not required; the results are valid for any field used in the realization of the lattice of propositions. Physical systems with the most general superselection rules are included in the theory. (auth)

24129 GENERALIZATION OF A THEOREM BY GOLDBERG AND SACHS. I. Robinson (Cornell Univ., Ithaca, N. Y. and Syracuse Univ., N. Y.) and A. Schild. J. Math Phys. (N. Y.), 4: 484-9(Apr. 1963).

A connection is established between algebraic degeneracy of the Weyl tensor, the existence of a null geodesic shear-free congruence, and certain restrictions on the Ricci tensor that are weaker than the gravitational equations for empty space. The result is roughly, with some important qualifications, that any two of these conditions imply the third. These restrictions on the metric are shown to be invariant under conformal transformations. (auth)

24130 UNIFIED VARIATIONAL FORMULATION OF CLASSICAL AND QUANTUM DYNAMICS. [PART] II. Edward M. Corson (Georgetown Univ., Washington, D. C.). J. Math. Phys. (N. Y.), 4: 519-21(Apr. 1963).

It is shown that the variational formulation, under the familiar classical canonical transformation to momentum space, automatically leads to the corresponding Schrödinger equations for the transition amplitudes between pure eigenstates of homologous variables in momentum space and to the unitarity of the formalism and the reciprocal Fourier integral relations between coordinate and momentum representations. Thus a long-standing gap in theory is bridged and the basic quantum commutators which are postulated in the more familiar Hamiltonian theory are uniquely derived. (auth)

24131 EIGENFUNCTION FORM OF THE NONRELATIVISTIC COULOMB GREEN'S FUNCTION. Koichi Mano (Wentworth Inst., Boston). J. Math. Phys. (N. Y.), 4: 522-9(Apr. 1963).

By treating the contour integrals in the momentum plane, the conventional eigenfunction form is deduced from the characteristic form for the nonrelativistic Coulomb Green's function. A straight-forward extension of the argument employed here leads to the most general form of the eigenfunction form. (auth)

24132 STUDIES IN PERTURBATION THEORY. PART I. AN ELEMENTARY ITERATION-VARIATION PROCEDURE FOR SOLVING THE SCHRÖDINGER EQUATION BY PARTITIONING TECHNIQUE. Per-Olov Loewdin (Uppsala Univ. and Univ. of Florida, Gainesville). J. Mol. Spectry., 10: 12-33(Jan. 1963).

The fundamental Schrödinger equation in quantum mechanics may be transformed to a discrete representation by introducing a complete set of basic functions in which the eigenfunctions may be developed. The eigenvalues are then determined by solving a secular equation, and this problem is attacked by a partitioning that leads to an implicit relation for the energy E of the form $E = f(E)$, which corresponds to the Schrödinger–Brillouin perturbation formula but has a more condensed form. The first-order iteration process based on the relation $E^{(k+1)} = f\{E^{(k)}\}$ is studied, and it is shown that, independent of whether this process is convergent or not, one can go over to a second-order process that appears to be closely connected with the variational expression. This second-order iterative procedure turns out to be very convenient for numerical work, particularly since it treats degenerate eigenvalues just as easily as the single eigenvalues. The general behavior of the curve $y = E - f(E)$ is discussed, and the method is illustrated by a few numerical examples. In an appendix, a brief survey of the classification of iteration processes is also given. (auth)

24133 FORMATIVE PROCESSES IN PULSED MICROWAVE DISCHARGES IN MIXTURES OF NEON AND ARGON. Takashige Tsukishima (Nagoya Univ., Japan). J. Phys. Soc. Japan, 18: 558-71(Apr. 1963).

In connection with studies for developing a microwave discharge chamber that detects tracks of charged particles, a number of important properties of a pulsed discharge were investigated. A pulsed microwave field of variable pulse widths, $\tau_p = 0.1 \sim 2\ \mu$ sec, was applied to a mixture of neon and argon at a total pressure of 100 mm Hg, but with various mixture ratio. The breakdown field strengths are approximately by one order of magnitude higher than those in continuous RF discharges and are less sensitive to the relative concentration of argon in neon, r, for smaller τ. The breakdown field strength decreases with increasing τ, reaches a minimum and increases again with a further increase of r, and the optimum value of r for the minimum breakdown field strength increases with decreasing τ_p. These properties can be explained in terms of the direct ionization whose relative contribution becomes predominant as E/p increases and/or τ_p decreases. The so-called Penning effect is found to be important only for a low value of E/p. The observed formative time lags and the time variation of particular line intensities are also in essential agreement with the theoretical analysis. (auth)

24134 DISCONTINUITIES AND SHOCK WAVES. [PART] I. Guy Boillat. Kgl. Norske Videnskab Selskabs, Forh., 35: 33-9(1962). (In French)

Discontinuities and shock waves are considered in semilinear field theory. The d'Alembertian and the mean curvature of the field are discussed. The cases of plane, cylindrical, and spherical waves are detailed. (T.F.H.)

24135 DISCONTINUITIES AND SHOCK WAVES. [PART] II. Guy Boillat. Kgl. Norske Videnskab Selskabs, Forh., 35: 40-7(1962). (In French)

Discontinuities and shock waves are studied in quasilinear field theory. The case of simple gravitational waves is discussed. The application of the results to fluid mechanics is outlined. (T.F.H.)

24136 EXPLODING WIRES AND THEIR USES. William G. Chace (Air Force Cambridge Research Labs., Bedford, Mass.). New Scientist, 18: 386-8(May 16, 1963).

The theory of exploding wires phenomena is briefly examined, and a scheme for classifying wire explosions on the basis of the wire vaporization time is described. Some uses of exploding wires (rocket guidance, metal shaping, photography, dense plasma sources, and shock wave production) are also mentioned. (D.C.W.)

24137 MAXIMUM EFFICIENCY CONDITIONS OF MAGNETOHYDRODYNAMIC POWER GENERATION. Yasutomo Ozawa and Masakuni Narita (Hokkaido Univ., Sapporo). Nippon Genshiryoku Gakkaishi, 5: 286-92(Apr. 1963). (In Japanese)

Maximum efficiency conditions of MHD power generation were derived as follows: (1) Spatially homogeneous distribution both of induced electromotive force and of the ratio of the applied magnetic induction to the density of a working fluid are required for irrespective of compressible or incompressible plasmas. (2) In the case of incompressible plasmas, a homogeneous distribution of the magnetic induction is requested. (3) The magnitude of the required external loading at optimum and maximum efficiency power conversion is determined and it is proved that the optimum value of loading exists in a light load region. (auth)

24138 ON THE MEAN LIFE OF H^- IONS IN ACCELERATING DEVICES. G. Darewych and S. M. Neamtan

(Univ. of Manitoba, Winnipeg, Can.). Nucl. Instr. Methods, 21: 247-8(Feb. 1963). (In English)

Estimates of the mean life of hydrogen ions against dissociation under the action of an applied electric field were made for a range of field strengths. The WKB approximation was applied to the associated barrier penetration problem in a proper three-dimensional setting. The fact that the effective barrier width in a radial direction is a function of this direction requires the averaging of the barrier transparency over solid angle, resulting in a considerably longer mean life than that estimated on a one-dimensional basis. Results of the calculations are presented graphically. (auth)

24139 ON THE ELECTROMAGNETIC SEPARATION METHOD OF PREPARING RADIOACTIVE SOURCES FOR PRECISION β-SPECTROSCOPY. I. Bergstroem, F. Brown, J. A. Davis, J. S. Geiger, R. L. Graham, and R. Kelly (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Instr. Methods, 21: 249-74(Feb. 1963). (In English)

With the recently developed techniques of high-resolution β-spectroscopy, the precision that can be realized is limited by source quality rather than the performance of the β-spectrometer. It is therefore of interest to consider in detail how source quality might be improved. An inert gas was used so as to study the problems of source preparation under the most difficult and general conditions. First, the general effect of source quality is examined experimentally by studying the shapes of the K 54.96 and the K 188.4 conversion lines from a wide variety of Xe^{125} sources using momentum-resolution settings of ~0.05% and ~0.1%. Techniques for decelerating ions and thus minimizing source thickness are then described, followed by experimental measurements of the ranges of Na^{24}, K^{42}, Rb^{86}, Cs^{137}, and Xe^{133} ions in Al and of Xe^{133} ions in Au. Experiments relating to the diffusion and to the long-term retention of inert-gas atoms in a variety of metal targets are described. Finally, a number of effects which tend to limit source strength are considered, including beam current, beam scattering and neutralization, target collection, source thickness, and sticking factors. (auth)

24140 THE EFFECT OF LINE BROADENING OF MÖSSBAUER RESONANT SOURCES AND ABSORBERS ON THE RESONANCE ABSORPTION. D. A. O'Connor (Univ. of Birmingham, Eng.). Nucl. Instr. Methods, 21: 318-22 (Feb. 1963). (In English)

The peak resonance absorption and the width of the transmission velocity curves were calculated for Mössbauer resonant source and absorber combinations in which the source and absorber have different effective line widths. The type of line broadening considered is that due to nonuniformity in the crystalline environments of either source or absorber resonant nuclei, and it was assumed to give a Lorentz line shape. The calculations were carried out in two different approximations, one for thin and the other for thick absorbers, and these approximations found to give values for the peak resonance absorption which agree over a large range of absorber thickness. The results are presented graphically, and a procedure is suggested for their use. (auth)

24141 ELECTRON SCATTERING MEASUREMENTS USING A DOUBLE FOCUSING BETA-RAY SPECTROMETER. C- J. Andreen (Chalmers Univ. of Tech., Goteborg), W. Parker, and H. Slaetis. Nucl. Instr. Methods, 21: 329-37(Feb. 1963). (In English)

The results of an investigation dealing with the measurements of reflected (backscattered) and transmitted (through-scattered) electrons are reported. The incident electron energy chosen in the measurement was 10 kev, and both back- and through-scattered electron energies were measured as a function of various angles of electron incidence. The scatterers made use of were commercially available metal foils of aluminum, silver, and gold. The distributions of the different electron energies are given together with the most probable and average energy loss, the latter being compared with the nonrelativistic stopping-power formula for electrons in matter. The backscattering coefficient for electrons, which are scattered through 170° from an aluminum foil, is given the value 0.2%. Working on the basis of the present experimental results, it would appear that a Fermi-Curie plot will not be subject to any practical scattering distortion for energies above 10 kev using an aluminum foil thickness below about 0.2 mg/cm^2. (auth)

24142 A METHOD OF PREPARING THIN POLYETHYLENE FOILS FOR (n,p) RADIATORS. G. Birkhoff (Kernforschungsanlage, Julich, Ger.). Nucl. Instr. Methods, 21: 353-4(Feb. 1963). (In German)

A method for preparing polyethylene foils for thin (n,p) radiators is described. These radiators will be used in neutron spectrometry. The method is based on the inelastic stretching of commercial polyethylene foils, which are available in standard thicknesses of 20μ, 30μ, 40μ, 50μ, and so on. The thickness of a stretched foil is about 0.18 times the thickness of the original foil. The variation of thickness in a 10 cm × 3 cm area of a stretched foil was within the accuracy of measurement of 0.04 mg/cm^2 in the considered range from 0.3 to 1.5 mg/cm^2. (Transmission measurements with C^{14}). (auth)

24143 A NOTE ON MAKING THIN β-RAY SOURCES BY ELECTROSTATIC SPRAYING. D. Michelson and H. O. W. Richardson (Bedford Coll., London). Nucl. Instr. Methods, 21: 355(Feb. 1963). (In English)

Observations are reported on the electrostatic spraying of beta-emitting deposits on Al disks. It was necessary to use ethanol solutions of at least 50 vol. % concentration, preferably 66 vol. %. Half-widths are reported for thorium B and Ce^{144} deposits. (D.L.C.)

24144 THE FOCUSING PROPERTIES OF LONG MAGNETIC LENSES. PART I. I. Lindgren and W. Schneider (Uppsala Univ.). Nucl. Instr. Methods, 22: 48-60(Mar. 1963). (In English)

The focusing properties of long magnetic lenses for charged particles are investigated systematically. The analysis is performed by numerical integration of particle trajectories for a number of different fields, covering a wide range of field forms. Only fields which are zero at the source are treated. All investigated fields are found to focus particles emitted from a point source or a small disk source on the axis for emission angles up to at least about 30 degrees. The focusing errors due to a finite transmission (spherical aberration) and to a finite source size (source image) are calculated. Both effects are strongly dependent on the field form but vary smoothly with the field parameters. This makes it possible to interpolate between the investigated cases. The source image is in almost all cases smaller and in some cases considerably smaller than the source itself. A strong correlation between the spherical aberration and the source image is found, i.e., a larger spherical aberration usually corresponds to a smaller source image at ring-focus and vice versa. The combined effect of the different focusing errors is discussed, and a new method is proposed for direct estimation of the effective transmission by means of the Monte-Carlo technique. (auth)

24145 THE FOCUSING PROPERTIES OF LONG MAGNETIC LENSES. [PART] II. I. Lindgren, G. Pettersson, and W. Schneider (Uppsala Univ.). Nucl. Instr. Methods, 22: 61-72(Mar. 1963). (In English)

The systematic investigation of the focusing properties of long axial symmetric magnetic lenses for charged particles is extended to fields that are non-zero at the source position. As in part I the focusing error due to a finite transmission (spherical aberration) and to a finite source size (source image) are calculated. The previously found strong correlation between these two effects still holds. The fields treated in this part have as a rule considerably smaller spherical aberration and larger source image than those discussed in part I. A simple rule is found for a rough estimation of the focusing properties of a given magnetic field. The most suitable type of field for different experimental conditions is discussed, and the optimum transmission and source size and the maximum luminosity is calculated for some typical cases under idealized conditions. (auth)

24146 EQUIVALENCE THEOREMS AND POINT TRANSFORMATIONS IN FIELD THEORY. P. P. Divakaran (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 42: 235-46(Apr. 1963). (In English)

It is shown that the invariance of the S-matrix under the addition of a 4-divergence to the Lagrangian density of a system of interacting fields allows one to derive various equivalence theorems in a very simple manner. A simple illustration of this method is followed by a discussion of a class of derivative couplings for which equivalence theorems can be proved. Applications of some exact equivalence theorems are then made to renormalizability problem and to the question of the generation of vector fields from local gauge invariance. Finally, the same invariance property is employed to prove the theorem that point transformations of the fields leave the S-matrix unchanged. (auth)

24147 EXACT SOLUTION OF A RELATIVISTIC QUANTUM FIELD THEORY. T. Pradhan (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 43: 11-30(May 1963). (In English)

The relativistic quantum field theory with derivative coupling $\mathcal{L}' = \lambda\bar{\psi}\gamma^{\mu}\psi\partial_{\mu}\phi$ between a Fermi field of spin $\frac{1}{2}$ and a neutral Bose field of spin zero is solved exactly by an explicit solution of the Tomonaga-Schwinger equation for Dyson's U-operator. It is shown that the theory can be renormalised by means of a single divergent renormalisation constant. The most remarkable feature of the theory is the occurrence of an essential singularity on the light cone in the fermion Green's function which makes it a non-tempered distribution, as a consequence of which the theory is not amenable to analytic continuation techniques or to Källén-Lehmann spectral representation technique. The S-matrix works out to be unity if the asymptotic states are constructed by the "adiabatic switching off" procedure. It is however, different from unity, giving rise to finite scattering, if the asymptotic states are constructed by the LSZ procedure. (auth)

24148 INVESTIGATION OF THE MASS RENORMALIZATION METHOD IN QUANTUM FIELD THEORY. M. Ram and N. Rosen (Israel Inst. of Tech., Haifa). Nucl. Phys. 43: 45-56(May 1963). (In English)

A technique is described for checking the mass renormalization method in quantum field theory in a special case. This suggests a way in which the usual mass renormalization conditions for quantum electrodynamics and other field theories can be written down immediately. (auth)

24149 ON GAUGE INVARIANCE FOR A NEUTRAL MASSIVE VECTOR FIELD. S. Bonometto (Università, Padua and I.N.F.N., Padua). Nuovo Cimento (10), 28: 309-19(Apr. 16, 1963). (In English)

Within the frame of local gauge vector theories of strong interactions, the problem of the compatibility between gauge invariance and nonzero mass of the vector fields carrying the interaction is taken into examination. This compatibility is shown with the help of a penta-dimensional formalism that is adequate also to point out the connection between the preceding approaches to the same problem of Stückelberg on one side, and of Ogievetski-Polubarinov on the other. (auth)

24150 MAGNETIC SYMMETRY AND ELECTRON-NUCLEUS INTERACTIONS IN MAGNETIC CRYSTALS. S. Shtrikman and D. Treves (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Letters, 4: 294-5(May 1, 1963). (In English)

Use of symmetry considerations to study effects that reverse under time reversal and are therefore typical of ordered magnetic materials is explained. Effects of external parameters such as electric fields, magnetic fields, and strains are considered. The form of the interaction tensors related to these parameters can be determined from magnetic site symmetry, the converse also being true. (D.C.W.)

24151 EXPERIMENTAL EVIDENCE OF A MINIMUM IN THE MELTING CURVE OF He^4. J. Wiebes and H. C. Kramers (Kamerlingh Onnes Laboratorium, Leiden). Phys. Letters, 4: 298-9(May 1, 1963). (In English)

In the course of melting He^4 for measurements on the specific heat of liquid He^4 at temperatures below 1°K under pressure, evidence for a minimum in the melting curve at 0.76°K was found. A value of 0.008 was obtained for the difference of the melting pressures at absolute zero and the minimum, and a value of 1.9 for the ratio of the longitudinal and transverse phonon velocities in the solid was derived. (D.C.W.)

24152 A FLUX PUMP FOR THE GENERATION OF HIGH PERSISTENT CURRENTS IN A SUPERCONDUCTING FOIL MAGNET. H. Van Beelen, A. J. P. T. Arnold, R. De Bruyn Ouboter, J. J. M. Beenakker, and K. W. Taconis (Kamerlingh Onnes Laboratorium, Leiden). Phys. Letters, 4: 310-12(May 1, 1963). (In English)

A flux pump that offers the possibility of changing the field in the foil magnet practically at will by regulating the field of the pumping magnet is described. Currents of up to 500 amps were generated in foils with pumping fields of only a few hundred Oersteds. Foil magnets of Nb, Pb–Bi, and Pb–Hg were tested with the flux pumps, and the Pb–Bi and Pb–Hg magnets revealed comparatively low current carrying capacities in fields perpendicular to the current. (D.C.W.)

24153 HAMILTONIAN APPROACH TO THE METHOD OF SUMMATION OVER FEYNMAN HISTORIES. H. Davies (Christ Church, Oxford). Proc. Cambridge Phil. Soc., 59: 147-55(Jan. 1963).

The Feynman method of quantization by summation over q-histories is extended to a summation over q,p-histories, corresponding to the classical variational method of treating q and p as independent variables. The equivalence of this q-p summation to the usual quantization procedure is shown in the Heisenberg picture by choosing convenient canonical coordinates and in the Schrödinger picture by obtaining the usual representations of the q,p operators. (auth)

24154 THE IONIZATION OF HYDROGENIC POSITIVE IONS BY ELECTRON IMPACT. A. Burgess and M. R. H. Rudge (Univ. of London). Proc. Roy. Soc. (London), Ser. A, 273: 372-86(May 21, 1963).

Calculations of the cross-section for ionization of He^+ by electron impact are described. Further calculations indicate the behavior of the ionization cross-sections of highly ionized systems in the hydrogen isoelectronic sequence. Detailed consideration is given to the numerical work required, and the results of various approximations are compared with experiment. (auth)

24155 ON PERSISTENT CURRENTS IN A SUPERCONDUCTING ALLOY. [PART] II. Kazumi Maki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 29: 333-40(Mar. 1963). (In English)

The detailed study of the current as a function of electron pair momentum is made for the case where $l/\xi_0 \ll 1$, where l is the mean free path and ξ_0 the correlation length of the electron pair. It is shown that the maximal current of the system is not the critical current but vanishes like $(1-T/T_{c0})^{1/2}$ near the critical temperature, which confirms qualitatively Rogers' suggestion that the maximal current in the presence of scattering is found simply by multiplying a factor $(l/\xi_0)^{1/2}$ on that for a pure superconductor. Also a brief discussion on the superconducting state without an energy gap is given. (auth)

24156 ON THE ELASTIC SCATTERING OF ELECTRONS OF NEARLY ZERO ENERGY BY HELIUM ATOMS. Tasuke Hashino and Hidehiko Matsuda (Kyushu Univ., Fukuoka). Progr. Theoret. Phys. (Kyoto, 29: 370-3(Mar. 1963). (In English)

The elastic cross section for the scattering of electrons by helium atoms at zero energy was calculated by using the variational method of Hulthén. For the ground state of helium atom the so called open-configuration wave function that introduces the radial correlation into the wave function was used. For the elastic cross section, the value $28.54a_0^2$ was determined. (auth)

24157 NONLINEAR ELECTRODYNAMICS OF SUPERCONDUCTORS WITH A VERY SMALL COHERENCE DISTANCE. R. H. Parmenter (RCA Labs., Princeton, N. J.). RCA Rev., 23: 323-52(Sept. 1962).

A study is made of the electrical properties of a homogeneous superconductor having a Pippard coherence distance much smaller than the London penetration depth, a situation that occurs if the normal-electron mean free path is made sufficiently small as a result of either disorder or boundary scattering. The appropriate nonlinear generalization of the London theory of superconductivity is obtained and compared with the phenomenological Ginzburg–Landau theory. An investigation is made of critical currents and magnetic fields. It is shown that an intermediate state will exist in external magnetic fields much higher than the thermodynamic critical magnetic field. (auth)

24158 STUDIES OF THE ION EMITTER BETA-EUCRYPTITE. Fred M. Johnson (RCA Labs., Princeton, N. J.). RCA Rev., 23: 427-46(Sept. 1962).

The physical properties of β-eucryptite associated with the phenomenon of lithium-ion emission were investigated. Measurements were made of its work function and activation energy as a function of lithium content. The electronic conduction mechanism in β-eucryptite was explored and the application of this material for plasma synthesis ($Li^+ - e$ plasma) was demonstrated. (auth)

24159 RAMAN SCATTERING OF LIGHT IN A CRYSTAL OF CESIUM BROMIDE. A. I. Stekhanov and A. P. Korol'kov (Ioffe Inst. of Physics and Tech., Leningrad). Soviet Phys.-Solid State (English Transl.), 4: 2311-14 (May 1963).

Raman scattering was studied in a crystal of cesium bromide. The second-order Raman spectrum of CsBr was obtained. The effect of temperature on the spectrum and state of polarization was investigated. It was found that the intensity of Raman scattering is determined not only by the bromine ion, but also by the cesium ion. The second-order spectrum was depolarized due to the high symmetry of the CsBr lattice. (auth)

24160 SECONDARY EMISSION OF DIELECTRICS AND SEMICONDUCTORS WHEN BOMBARDED WITH POTASSIUM IONS. I. A. Abroyan and V. P. Lavrov (Kalinin Polytechnic Inst., Leningrad). Soviet Phys.-Solid State (English Transl.), 4: 2382-5(May 1963).

An investigation was made of the secondary emission properties of single crystals of the alkali-halide compounds LiF, NaF, NaCl, KBr, and CsCl and of a single crystal of silicon, when their surfaces are bombarded with potassium ions having energies from 40 to 7000 ev. Among the secondary particles are found positive ions of alkali metals as well as negative halogen ions and molecular ions of alkali-halide compounds. New information was found on how the positive and negative ion-ion emission coefficients vary with the energy of the primary ions. A dependence of the ion-electron emission coefficients γ on the target temperature was observed. (auth)

24161 CERENKOV RADIATION AND SUPPLEMENTARY WAVES IN A DIELECTRIC. F. G. Bass, M. I. Kaganov, and V. M. Yakovenko (Inst. of Radio Physics and Electronics, Academy of Sciences, Ukrainian SSR and Khar'kov Inst. of Physics and Tech.). Soviet Phys.-Solid State (English Transl.), 4: 2386-9(May 1963).

The spectral density of the radiation is calculated for a particle moving perpendicularly to the boundary of a dielectric. The presence of supplementary transverse waves caused by spatial dispersion is taken into account. The effect of the boundary conditions for the polarization vector is examined. (auth)

24162 THE SURFACE DISTRIBUTION OF GAMMA-RAY INTENSITY FROM A SOURCE WITH A VARIABLE DENSITY OF THE RADIOACTIVE SUBSTANCE. Vladimir Cermak (Geophysical Inst., Czechoslovak Academy of Sciences, Prague). Studia Geophy. Geodaet., Ceskoslov. Akad. Ved., 7: No. 1, 45-52(1963).

A theoretical formula is calculated for the gamma-ray intensity on the surface located above an arbitrary spherical and symmetrical radiating solid. A radiometric method was applied to determine dimensions of the shattered zone during an explosion in solid material. The formula can also be used for geophysical prospecting for radioactive materials and for determining the irradiation zone after an A-bomb underground explosion. Simple models are used to show a practical application of the formula in practice. (auth)

24163 THEORETICAL ANALYSIS OF THE RADIAL FIELD VORTEX MAGNETO-GAS DYNAMIC GENERATOR. Richard A. Elco, William F. Hughes, and Frederick J. Young (Carnegie Inst. of Tech., Pittsburgh). Z. Angew. Phys., 13: 1-12(1962). (In English)

Vortex flow that increases the interaction length for ionized gases and the magnetic field is analyzed in the case of the magneto-gas dynamic generator. The configuration considered has a radially applied magnetic field and the electrodes are parallel flat disks that confine the flow. Since the equations that describe the system involve coupled non-linear terms, approximations are made to obtain,

explicitly, the mechanical, electrical, and thermal characteristics of interest. (C.E.S.)

24164 ON THE MOTION OF VISCO-ELASTIC ELECTRICALLY CONDUCTING LIQUID IN THE PRESENCE OF A MAGNETIC FIELD. Jai P. Agarwal and Mahinder K. Jain (Indian Inst. of Tech., Kharagpur, India). Z. Angew. Math. Phys., 13: 152-60(1962). (In English)

The effect of elastic elements on the flow of an electrically conducting liquid in the presence of a magnetic field was examined in detail for the case of plane Poiseuille flow and it was found that the flow is characterized by the two non-dimensional numbers M (the Hartmann number), and K [= $(3\ \tau\nu_c/\nu_1)\ (U_0^2/L^2)$] the visco-elastic number; the effect of elastic elements is to increase the flattening of the velocity profile; for small values of M, the effect of elastic elements on the flow is considerable while for large values of M, this effect is negligible; the shear stresses and the equation giving pressure are modified by the inclusion of cross-viscosity. (auth)

24165 ELECTRON OPTICS IN MULTI-STAGE LENS SYSTEM. [PART] I. Minoru Morikawa (Nissin Electric Co. Ltd., Kyoto). Z. Angew. Math. Phys., 13: 167-75(1962). (In English)

The optics of a system composed of a series of two-cylinder electron lenses are investigated. The focal lengths and image and object distances are derived for the case that each two-cylinder lens has a finite gap length between the cylinders. (C.E.S.)

24166 ELECTRON OPTICS IN MULTI-STAGE LENS SYSTEM. [PART] II. Minoru Morikawa (Nissin Electric Co. Ltd., Kyoto). Z. Angew. Math. Phys., 13: 279-88(1962). (In English)

The formulas for the relativistic focal length and image and object distances are obtained for a multi-stage electron lens system. The system is composed of coaxial two-cylinder lenses, the centers of which are separated, and the cylinders have a finite gap length between them. A comparison of relativistic and non-relativistic lens systems is also presented. (C.E.S.)

24167 ELECTRON OPTICS IN MULTI-STAGE LENS SYSTEM. III. RELATIVISTIC LENS. Minoru Morikawa (Nissin Electroc Co. Ltd., Kyoto). Z. Angew Math. Phys., 14: 80-4(1963). (In English)

The relativistic focal lengths and distances from lens center to focal points of co-axial two-cylinder lenses are compared with non-relativistic. The ratio of focal lengths and distances from lens center to focal points are calculated for three representative co-axial two-cylinder lenses. The focusing power is smaller in the relativistic case for electron beam energies less than 2.044 Mev. (C.E.S.)

24168 MAGNETOHYDRODYNAMIC SHOCK PROPAGATION IN NON-UNIFORM DUCTS. Roy M. Gundersen (Univ. of Wisconsin, Madison). Z. Angew. Math. Phys., 14: 124-34(1963). (In English)

The perturbation produced when an initially plane magnetohydrodynamic shock wave encounters an area variation in a duct is determined. The problem is linearized on the basis of small area variations. To ensure that all changes in the behavior of the shock are caused by the non-uniform area, it is assumed that the area variations are confined to the region $X > 0$ while to the left of the section the tube is of constant area and the initially plane shock propagates through this portion with constant speed. The fluid in front of the shock is assumed at rest. (C.E.S.)

24169 ON A SINGULAR PERTURBATION PROBLEM IN MAGNETOHYDRODYNAMICS. I-Dee Chang (Stanford Univ., Palo Alto, Calif.). Z. Angew. Math. Phys., 14: 134-47(1963). (In English)

A singular perturbation method is demonstrated in calculating the effect of a magnetic field on a steady, incompressible, viscous, and electrically conducting flow past a body of revolution. A uniform description of the entire flow field is presented for various body shapes. (C.E.S.)

24170 ELECTROMAGNETIC EJECTION OF A SPHERICAL BODY FROM A CONDUCTING FLUID. U. Ts. Andres, L. S. Polak, and S. I. Syrovatskii (Inst. of Natural Fuels, Academy of Sciences, USSR and Inst. of Petroleum-Chemical Synthesis, Moscow). Zh. Tekhn. Fiz., 33: 263-7 (Mar. 1963). (In Russian)

Equations and calculations are used in a detailed analysis of the ejecting force acting upon a spherical body placed in a homogeneous incompressible liquid. Measurements were carried out using an installation consisting of a C-shaped magnet with 25-cm pole diameter and 10-cm gap. The intensity of the field varied from 2000 to 5000 gauss. (R.V.J.)

24171 ELECTRIC FIELDS OF CHARGED PARTICLE CLUSTERS. A. D. Sushkov and S. I. Molokovskii (Leningrad Electro-technical Inst.). Zh. Tekhn. Fiz., 33: 326-36 (Mar. 1963). (In Russian)

Formulas and graphs were developed that show electric fields of axially-symmetric disc-shaped bundles of charged particles inside a metallic tube with a heterogeneous charge distribution along the axis of the bundle. The bundle fields with various charge distributions are correlated. (tr-auth)

24172 PRODUCTION OF CONSTANT MAGNETIC FIELDS OF A GIVEN SHAPE BY MEANS OF IMPLICIT MAGNETIC SYSTEMS. G. V. Badalyan (Erevan Inst. of Physics, Academy of Sciences, Armenian SSR). Zh. Tekhn. Fiz., 33: 345-9(Mar. 1963). (In Russian)

Production of constant magnetic fields with ordered distribution by means of implicit magnetic systems is described. A homogeneous magnetic field prepared by means of a sinusoidal winding was successfully used as a correcting factor in synchrophasatron injections at Dubna. (R.V.J.)

24173 ION-ELECTRON EMISSION FROM METALS IN THE PRESENCE OF HYDROGEN. A. A. Dorozhkin and N. N. Petrov (Leningrad Polytechnic Inst.). Zh. Tekhn. Fiz., 33: 350-5(Mar. 1963). (In English)

Induced electron stripping by 1 to 30 kev H^+, H^{2+}, and H^{3+} ions bombarding tungsten, molybdenum, nickel, and copper targets was studied at various temperatures. It was found that electron emission from W, Mo, and Ni is not a function of hydrogen pressure near the target in the pressure range at 10^{-6} to 4 to 6×10^{-2} torr. With cold copper the γ coefficient increases with hydrogen pressure over 10^{-3} torr. (R.V.J.)

24174 ATOMIC AND NUCLEAR PHYSICS. Theoretical Principles. H. D. Bush. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1963. 225p. $8.95.

Special properties of atomic particles and atomic systems that do not enter into macroscopic consideration are presented. Nuclear properties relevant to reactor technology and neutron reactions and interactions in the neutron chain reaction are discussed. Thermonuclear reactions as a possible source of power on a commercial scale and basic phenomena associated with the passage of ionizing radiation through matter are considered. (C.E.S.)

24175 THE AUGER EFFECT AND OTHER RADIATIONLESS TRANSITIONS. E. H. S. Burhop. Cambridge Monographs on Physics. Cambridge, Eng., University Press, 1952. 199p.

An extensive discussion of the Auger effect is presented along with a discussion of the internal conversion of γ radiation. Other topics treated include internal electron pair production and the rate of Auger processes in meson capture. Radiationless transition processes in atomic and molecular spectra are also considered. (C.E.S.)

24176 PROCEEDINGS OF THE EASTERN THEORETICAL PHYSICS CONFERENCE, UNIVERSITY OF VIRGINIA, OCTOBER 26-27, 1962. M. E. Rose, ed. New York, Gordon and Breach, Science Publishers, 1963. 468p. $5.00.

Twenty-four papers were presented on the general topics of nuclear physics, particle physics, and general relativity. Separate abstracts have been prepared for 20 papers. The remaining 4 were abstracted previously in NSA. (M.P.G.)

24177 VIBRATIONS AND SINGLE PARTICLE EXCITATIONS IN NUCLEI. G. E. Brown (Massachusetts Inst. of Tech., Cambridge). p.1-23 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The theory of excitations in nuclei is discussed. The one strong state of given multipolarity and isospin observed in inelastic scattering experiments is referred to as a vibration. The remaining excitations are called single-particle excitations. The case of closed-shell nuclei and odd parity vibrations is considered in terms of particle-hole excitation. Methods of solving for the perturbed states are described, and the effects of collective excitations are discussed. Vibrations are closely related to the nucleon-nucleon force, and calculations should provide valuable information by making the connection between nucleon-nucleon forces and nuclear spectra. (M.P.G.)

24178 THE EFFECT OF PAIRING CORRELATIONS ON NUCLEAR BETA DECAY FOR SPHERICAL NUCLEI. Raymond A. Sorensen (Carnegie Inst. of Tech., Pittsburgh). p.39-51 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

A model is considered in which the shell-model protons and neutrons interact with pairing forces which are effective for a pair of protons or neutrons in a state of zero angular momentum. This interaction is approximately diagonalized by the quasi-particle transformation of Bogelubov. The low-energy states of an odd-proton (neutron) nucleus are then the one-proton (neutron) quasi-particle states, while the ground state of an even-even nucleus is the quasi-particle vacuum. The low states of an odd-odd nucleus have a pair of quasi-particles, one a neutron and one a proton. The nucleus matrix elements of β decay between such states may be written as a "single particle" matrix, element multiplied by a reduction factor depending on the occupation factors (U,V) of the quasi-particle transformation. For odd-mass transitions the reduction factor is $U_N U_P$ ($V_N V_P$) if a particle of the odd (even) group makes the transition. For an odd-odd to even-even transition it is $V_N U_P$ ($U_N V_P$) for a proton (neutron) transition, i.e., $p \rightarrow n(n \rightarrow \rho)$. A good correlation is found between these reduction factors (obtained from other considerations) and the experimental ft values for a large number of allowed, $\Delta J = \pm 1$, transitions from mass number 57 to 136. (auth)

24179 SINGLE-NUCLEON DAMPING OF COLLECTIVE VIBRATIONS. Richard A. Ferrell (Univ. of Maryland, College Park). p.53-78 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The giant dipole resonance in O^{16} is investigated. Extended shell-model calculations are applied to the determination of the breadths of the maxima that occur at ~22 and 24 Mev. Damping is taken into account by including excitations into all of the different possible s- and d-states. The effect of the continuum single-particle states are omitted in the original wave function and included in the next step as a weak perturbation. The calculations are described without numerical details. (M.P.G.)

24180 EXTERIOR WAVE FUNCTIONS FOR THE TRITON GROUND STATE. B. V. Bayman (Princeton Univ., N. J.). p.79-85 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The construction of exterior wave functions for the ground state of the triton is described. The triton is specialized by considering an even-parity state with total angular momentum $\frac{1}{2}$, a fixed z component, and a specified permutation symmetry corresponding to an isospin of $\frac{1}{2}$. A table is constructed showing the appropriate exterior "radial" equation and the structure of the wave function for the different possible combinations of orbital and spin angular momenta and orbital permutation symmetries. It is shown that the symmetries and energy eigenvalue alone are not sufficient to determine the asymptotic behavior of the wave function in the three-particle problem, as they are in the two-particle problem. (M.P.G.)

24181 NUCLEAR STRUCTURE INFORMATION FROM INELASTIC ELECTRON SCATTERING. L. C. Biedenharn (Duke Univ., Durham, N. C.). p.87-112 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The type of information that could be obtained from inelastic electron-scattering experiments is summarized. The mechanism of the inelastic process is discussed in connection with the study of nuclear levels. The difficulties in inelastic electron-scattering analysis are described, but it is shown that, for nuclear structure work, the part of the calculation which involves a specific nucleus is confined essentially to the penetrating orbits, just as in the elastic scattering problem. Electron inelastic scattering is primarily a probe of the nuclear surface region. The results of analysis of some typical experimental data are discussed. The Born approximation expression for inelastic electron scattering is shown to be inaccurate. (M.P.G.)

24182 ORIENTATION EFFECTS IN NUCLEAR EXCITATION BY INELASTIC ELECTRON SCATTERING. M. E. Rose and L. J. Weigert (Univ. of Virginia, Charlottesville). p.113-25 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The scattering from oriented nuclei with polarized and unpolarized electron beams is considered. Attention is restricted to electric dipole excitation, and the Born approximation is used. An expression for the differential cross section for the excitation process with orientation is obtained. Orientation effects will be observable when both the beam and the target are polarized and/or the target is aligned. Electron polarization alone has no effect on the cross section, but target alignment changes the cross section independently of the state of polarization of the incident beam. The theory is applied to the excitation of the 2^- level of B^{10} at 7.48 Mev by electrons of ~50 and 100 Mev, and results are presented in graphs. Results indicate that the orientation effects (with the possible exception of the asymmetry factor for transversally polarized electrons) are accessible to experimental measurement. The work must

be extended to include retardation effects and higher multipoles to obtain information relevant to nuclear structure. (M.P.G.)

24183 ANALYTICITY IN PARTICLE PHYSICS. S. B. Treiman (Princeton Univ., N. J.). p.127-74 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The present status of analyticity in the service of particle physics is reviewed. The expectations of what might be achieved from analysis of scattering kinematics are discussed. The three "great conjectures" of particle-physics analysis are Goldberger's dispersion relations for forward pion-nucleon scattering, the Mandelstam representation, which asserted analyticity properties in energy and momentum transfer variables, and Regge's introduction of complex angular momentum into the analysis of potential scattering. These conjectures are described in some detail. The application of analyticity methods to high-energy scattering behavior and polology is summarized. (M.P.G.)

24184 AN ANALYSIS OF ELECTRON-NUCLEON SCATTERING. J. S. Levinger and M. W. Kirson (Cornell Univ., Ithaca, N. Y.). p.175-84 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

Fitting experimental values of differential cross sections for electron-nucleon scattering to the dispersion-theoretic form $G(t) = (1/\pi)\int_0^\infty g(t')dt'/(t' - t)$ is described. Different spectral functions $g(t')$ are chosen for the isovector and isoscalar parts of the electric and magnetic form factors. Two separate fits, regarded as only fairly satisfactory, are described. The examples indicate that, once a specific equation is assumed for the form factors, the values of the parameters are rather accurately determined by published data. The data fitting is being continued by introducing more parameters. (M.P.G.)

24185 REVIEW OF PION RESONANCES. Jack Steinberger (Columbia Univ., New York). p.185-210 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The pion resonances ρ, ω, and η, are discussed. The ρ resonance was found in the reactions: $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ and $\pi^- + p \rightarrow \pi^+ + \pi^+ + n$. The central mass is 750 Mev, and the ρ has spin 1 and negative parity. The ω was discovered in the reaction $p + \bar{p} \rightarrow 2\pi^+ + 2\pi^- + \pi^0$. The mass is ~782 Mev, and the isotopic spin is 0. The η was found in the 3-pion system of the reaction $\pi^+ + d \rightarrow p + p + \pi^+ + \pi^- + \pi^0$. The isotopic spin is 0, and the mass is ~548 Mev. Interpretations of the reactions and properties of the resonances are discussed. The resonances are found in large quantities in p-p collisions, π-p and π-d collisions, and proton-antiproton annihilation. (M.P.G.)

24186 STRONG INTERACTIONS—K MESON AND BARYON RESONANCES. George A. Snow (Univ. of Maryland, College Park). p.211-35 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

Particle resonances exclusive of multipion resonances are reviewed. The boson resonance, $K^* \rightarrow K + \pi$, is described, and methods of deducing its spin are discussed. The baryon resonances with strangeness S = 0, -1, and -2 are tabulated with information on their mass, spin, and parity. The resonances are discussed with respect to the SU_3 group and the eight-fold-way method of classifying known particles and resonant states. The Regge Pole Theory is also considered. Possible pairs to fit the theory are mentioned, but better determination of quantum numbers are needed to confirm or deny the conjectured trajectories. (M.P.G.)

24187 K^+-PROTON SCATTERING AT LOW ENERGY. C. Costa (CERN, Geneva), A. Zimerman, and R. L. Gluckstern. p.247-65 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

An analysis of existing information on the K^+–nucleon scattering interaction is reported. Only the I = 1 state is considered. Starting from a simple, general analysis of the scattering amplitude, experimental data are used to infer information about the different roles of the possible interactions in the $K^+ - p$ system. The possible effects of the Born terms and the pion exchange terms are considered separately. The results of some typical Born fits and ρ-meson fits are reported and discussed. (M.P.G.)

24188 NEW APPLICATIONS OF THE BOUNDARY CONDITION MODEL OF STRONG INTERACTIONS. E. L. Lomon, H. Goldberg, W. W. S. Au, and C. N. Yen-Liu (Massachusetts Inst. of Tech., Cambridge). p.267-81 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The Boundary Condition Model (B.C.M.) is applied to the π-π, π-N, K-N, and $\bar{K}$-N systems. The application of the B.C.M. to elastic and inelastic pion-nucleon scattering in S states is described. The B.C.M. can be used in its two-channel form to couple the π-N and (ABC)-N states, using the concept of the T = 0 two-pion state being a particle with a certain average mass. The pion-pion S- and P-state interactions are also discussed. Preliminary work indicates the value of the B.C.M. approach to approximating a Mandelstam amplitude. Good results were obtained by applying the B.C.M. to S-state K-N scattering data and to T = 0 $\bar{K}$-N interactions. (M.P.G.)

24189 REMARKS ON WEAK INTERACTIONS. C. N. Yang. p.293-301 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The proof that the neutrino associated with the muon is not the same as the neutrino associated with the electron is outlined. To determine the small mass of ν_μ, a process in which the momentum of the neutrino is small must be used. Future experiments with high-energy neutrinos may yield information on the form factor g_A and the production of intermediate bosons. The existence or nonexistence of $\Delta Q = -\Delta S$ weak interactions is very important in the study of the structure of weak interactions. (M.P.G.)

24190 ONE FOUR-COMPONENT NEUTRINO. S. A. Bludman (Univ. of Pennsylvania, Philadelphia). p.303-12 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The idea that the two two-component neutrinos (ν_L, ν_R) and (ν'_L, ν'_R), coupled to (e^-, e^+) and (μ^-, μ^+) respectively, be taken together to form a single four-component Dirac neutrino $\nu = (\nu_L, \mu'_R)$ distinguished, by its leptonic charge, from its antiparticle $\nu^c = (\nu_R, \nu'_L)$ is discussed. This idea involves giving up the two-component neutrino theory, and making e^-, ν, μ^+ particles so that unobserved transitions are forbidden by lepton number. To show that this formulation may be regarded as necessary, the conventional tests of lepton conservation are analyzed. It is shown that there can be no test of lepton conservation or lepton number assignments in iterated β-decay processes because of neutrino chirality, and in μ-decay because of the presence of 2 neutrinos. Two-step Fermi processes in which the neutrino is emitted and absorbed by 2 different Fermi interac-

tions must be studied. An experimental test between the proposed theory and the theory of 2 two-component neutrinos is possible, in principle, if neutrino chirality conservation is broken or other neutrino interactions are discovered which do not have the symmetry of the weak interactions. (M.P.G.)

24191 BARYON DOUBLETS AND NEUTRINO DOUBLETS. E. J. Schremp (Naval Research Lab., Washington, D. C.). p.313-32 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

A mathematical extension of Weyl's 2-component spinor formulation of Dirac's wave function is discussed. This "quaternion formulation" of the Dirac theory yields a comprehensive description of most of the elementary particles of spin $\frac{1}{2}$ that are presently known. The algebraization of the Weyl wave equation, leading to a quaternion description of the nucleon, is described. The quaternion wave functions may be said to represent superpositions of spin and isospin states, and a symmetric relationship between isospin and ordinary spin is revealed. The physical interpretation of the quaternion formulation and the application of the mathematical operations to baryons and leptons are discussed. (M.P.G.)

24192 MASS OF VECTOR PARTICLES IN A GAUGE INVARIANT THEORY. Bruno Zumino (New York Univ., New York). p.333-43 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The question of mass in a gauge-invariant theory is studied by considering a model field theory such as two-dimensional quantum electrodynamics. An exact operator solution of the Heisenberg equations of motion in the Coulomb gauge reveals that the physical mass, m_1, of the photon is different from zero for arbitrarily small values of the charge, e, and is given by $m_1^2 = e^2/\pi$. This result is compared with gauge-invariant perturbation theory, and it is concluded that the question of the photon mass can only be answered by a more detailed investigation of the dynamics of the theory. The interaction with a spinor field of a vector meson having a finite base mass is also discussed. It is shown that the vector meson theory provides, in the limit, the solution obtained directly for quantum electrodynamics. In the two models discussed, a perfectly covariant theory is provided by choosing space-like limits for the operator products occurring in the Heisenberg equations of motion. (M.P.G.)

24193 DECOMPOSITION OF LORENTZ AND FOLDY-WOUTHUYSEN TRANSFORMATION. Herbert Jehle, William C. Parke, and Charles Ernest Rossi (George Washington Univ., Washington, D. C.). p.345-51 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

The decomposition of proper Lorentz transformations into spinor transformations is described. This is illustrated by discussing a Foldy-Wouthuysen transformation in connection with a transformation of a free electron from the (unprimed) laboratory system to the (primed) rest system. (M.P.G.)

24194 THE QUANTIZATION OF GEOMETRY. Bryce S. DeWitt (Univ. of North Carolina, Chapel Hill). p.353-86 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

Two aspects of theoretical physics, the epistemological analysis of space and time and the quantum-mechanical notions of observation, measurement, and indeterminism, have remained sharply distinguished. Some of the ideas involved in the problem of removing this division are discussed. The problem is referred to as "the quantization of the gravitational field." (M.P.G.)

24195 Q-NUMBER COORDINATE TRANSFORMATIONS AND THE ORDERING PROBLEM IN GENERAL RELATIVITY. James L. Anderson (Stevens Inst. of Tech., Hoboken, N. J. p.387-99 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

Some difficulties encountered in the quantization of general relativity are discussed. All parts of the metric are considered to be operators defined on a linear vector space, and the freedom of coordinate transformations is restricted afterwards by imposing coordinate conditions. The transformation which effects the transition from one set of coordinate conditions to a finitely different set will appear as a q-number transformation. A consistency condition is obtained, which is shown to arise as a necessary condition for the construction of finite q-number coordinate transformations. The satisfaction of the consistency condition reduces to finding an ordering of factors in the classical expressions for the constraints. It is shown that the consistency condition cannot be satisfied for the case of general relativity. (M.P.G.)

24196 GRAVITATION FROM A FIELD THEORETICAL VIEWPOINT. R. Arnowitt (Northeastern Univ., Boston). p.401-32 of "Eastern Theoretical Physics Conference." New York, Gordon and Breach, Science Publishers, 1963.

A brief discussion of the Einstein field equations is given. It is shown how they arise from the physical postulate of the principle of equivalence and the usual conditions imposed on Lorentz covariant fields. The implications of the general coordinate covariance (a gage invariance for the theory) are discussed. The canonical reduction of the theory is described. The canonical analysis leads to an expression for energy-momentum, which is a Lorentz four vector, and to a simple description of gravitational radiation. The net result of the analysis is that the differences between general relativity and other field theories are more in detail than in general structure. The formal structure of general relativity is similar to any of the other fields in microscopic physics. (M.P.G.)

Astrophysics and Cosmology

Refer also to abstract 22974.

24197 (CRL-41(2nd Ed.)) STELLAR EVOLUTION, NUCLEAR ASTROPHYSICS, AND NUCLEOGENESIS. A. G. W. Cameron (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1957. Reprinted Dec. 1961. 195p. (AECL-454)

Notes for a series of lectures on stellar evolution, nuclear astrophysics, and nucleogenesis are presented. Topics covered include galaxy development, nuclear and thermonuclear reactions (particularly heavy-ion, helium, and hydrogen reactions), reaction rates, stellar evolution, abundances of elements and nuclides, stellar evolution, supernova explosions, neutron capture, physical conditions in stellar interiors, and the Hertzsprung-Russell diagrams. 100 references. (D.C.W.)

24198 (UCRL-7065-T) CALCULATION OF STELLAR INTERIORS AND STELLAR ENVELOPES. Carl A. Rouse and Robert P. Dickinson, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 1962. Contract W-7405-eng-48. 3p.

Avoidance of several limitations on calculations of stellar interiors by use of an ionization equilibrium equation of state for an element mixture is described, and some results of a calculation of a stellar envelope and interior for a five-element mixture are discussed. The calculation was terminated at a temperature $T \approx 0.5$ ev (5800°K) to reproduce the sun's profile. Features noted were: a decrease of the effective value of $\gamma - 1$ in the outer 2% of the radius with an increase at the T = 0.5 ev surface, and an increase of the mean molecular weight in the same area. Pressure in the envelope varied as $T^{3.3}$, not as the usually assumed $T^{2.5}$. (D.C.W.)

24199 ABUNDANCES IN G DWARFS. VI. A SURVEY OF FIELD STARS. George Wallerstein (Univ. of California, Berkeley). Astrophys. J., 6: Suppl. Ser., 61, 407-44(Feb. 1962).

Data are presented for deriving the abundances of the elements in 21 field stars of very nearly solar type. Iron-to-hydrogen ratios are obtained from curves of growth for which the ionization temperatures are determined by considering both the excitation temperatures and the effective temperatures. The effective temperatures are derived both from the B−V colors (corrected for line blanketing) and the G−R colors of the six-color photometry system. The abundance ratios of ten other elements to iron are then derived. This material is combined with results for 13 other G dwarfs and is discussed from the point of view both of the nuclear reactions responsible for element building and of problems of galactic structure and stellar populations. There seems to be a correlation between a star's metal abundances and the velocity parameter derived from the curve of growth, in that stars with low metal content have less turbulence. The correlation between a G dwarf's ultraviolet excess and its metal deficiency is confirmed and strengthened. The relative abundances of the metals do not remain constant. Trigonometric parallaxes show that 7 stars definitely lie above the main sequence. Six of these must be very old, about 15×10^9 years, and 4 of these 6 are slightly metal-rich. A discussion of the motions of these stars in the galactic plane shows that both metal-rich and metal-poor stars are found with nearly circular orbits, but all the stars with large velocities with respect to the local standard of rest are metal-poor. When the stars are plotted in the Haus-Bottlinger diagram with the ratio of the α elements Mg, Si, Ca, and Ti to iron as the parameter, a clear division is seen, in that all the α-rich stars are high-velocity stars whose perigalactic distances are about ½ or less than the distance from the sun to the galactic center. All metal-poor stars with velocities near the circular velocity have normal ratios of the α-elements to iron. Such a separation is taken to indicate that the high-velocity stars were formed in their present orbits rather than having been scattered out of circular orbits. An analysis of the motions perpendicular to the galactic plane shows that the velocity dispersion increases steadily for stars of increasing metal deficiency. (auth)

24200 THE THEORY OF SYNCHROTRON RADIATION FORM [FROM] STARS WITH DIPOLE MAGNETIC FIELDS. Kip S. Thorne (Carnegie Inst. of Washington, Cold Spring Harbor, N. Y. and California Inst. of Tech., Pasadena). Astrophys. J., 8: Suppl. Ser., 73, 1-30(Feb. 1963).

A simple model of a star whose radiation is partially due to the synchrotron mechanism is analyzed. The model consists of a normal star with a strong dipole magnetic field outside its surface, in which ultra-relativistic electrons are spiraling. The polarization and intensity of the synchrotron component of the radiation are calculated as functions of the frequency of the radiation, the observer's orientation, the energy distribution of the ultra-relativistic electrons, and their pitch-angle distribution. The degree of polarization of the synchrotron component from the most plausible models is found to be 20 to 40 per cent for an observer located in the equatorial plane and to drop off in a $\sin^2 \theta_0$-like curve to 0 per cent for an observer located on the polar axis. The spectrum of the synchrotron component is characterized by a $(1/\nu)^n$ dependence; n remains constant (about ⅓ or ½) except at high frequencies, where it begins to increase gradually. The maximum power is emitted at the lower end of the high-frequency region, where $n \approx 1$. The characteristics of the combined synchrotron and thermal radiation are examined for various stellar models, and lower limits are placed on the surface magnetic-field strengths required to produce a given degree of polarization. The lower limit is 100 gauss for a polarization of 0.05 per cent and 1000 gauss for 10 per cent. The dependence of the polarization of the combined radiation on frequency is examined. The degree of polarization and the color excess of the combined radiation are correlated for main-sequence stars using a U, B, V diagram. The characteristics of the emission from an oblique rotator containing significant amounts of synchrotron radiation are examined and compared with the emission from the star HD 71866. The synchrotron radiation from objects with turbulent magnetic fields is compared with that from a number of randomly oriented dipole magnetic fields. (auth)

24201 EVOLUTIONARY TIME SCALES FOR LATE CARBON-BURNING PHASES WITH NEUTRINO EMISSION. Richard Stothers (Harvard Coll., Cambridge, Mass. and Inst. for Space Studies, New York). Astrophys. J., 137: 770-6(Apr. 1, 1963).

The effect of the two most important neutrino processes (pair annihilation and photoneutrino) is evaluated for stars during the carbon-burning stage. At this point, luminosity $L_\nu > L$ (photon), and the evolution of the core can be considered separate from that of the envelope. The time scale of evolution from carbon depletion to the onset of neon-burning is estimated from representative central densities and the corresponding critical temperatures, $T \gtrsim 0.5$ B°K, at which the energy generation due to the $C^{12} + C^{12}$ reaction is equaled by the energy loss from neutrinos. If the degeneracy is high ($\rho \sim 10^6$ gm/cm^3), neutrino emission accelerates cooling of the star. In both cases the evolution is limited only by the rate of neutrino emission. (auth)

24202 ABUNDANCE OF TRACE ELEMENTS AND NON-EQUILIBRIUM EFFECTS. Hollis R. Johnson (Yale Univ., New Haven). Astrophys. J., 137: 858-62(Apr. 1, 1963).

It is shown generally that departures from local thermodynamic equilibrium must be small for trace elements in the solar atmosphere. Approximate numerical results for Be I demonstrate that departures from equilibrium cannot account for the difference between solar and meteoritic values for the beryllium abundance. (auth)

24203 UNSTABLE MODES IN THE SOLAR HYDROGEN CONVECTION ZONE. Karl-Heinz Boehm (Univ. of California, Berkeley). Astrophys. J., 137: 881-900(Apr. 1, 1963).

For the model of the solar hydrogen convection zone suggested by Böhm-Vitense, the fundamental modes with horizontal scales in the range 500 km $\leq (\lambda/2) \leq$ 50000 km and their growth rates were calculated, using the linearized hydrodynamic equations and including the effects of radia-

tive transfer. The variation of the mean temperature T_0 and density ρ_0 with depth, the dependence of the other thermodynamic functions on T_0 and ρ_0 for a partially ionized mixture of hydrogen and helium, and the detailed depth dependence of the opacity and its derivates were taken into account. A detailed model of the stable photosphere and a schematic model of the lower parts of the chromosphere were incorporated in the Böhm-Vitense model, in order to study the penetration of the convective motion into the stable part of the atmosphere. The conclusions from the calculations are presented. (auth)

24204 HYDRODYNAMIC OSCILLATIONS IN THE SOLAR CHROMOSPHERE. J. Bahng and M. Schwarzschild (Princeton Univ., N. J.). Astrophys. J., 137: 901-13 (Apr. 1, 1963).

Compression waves in the chromosphere, with the motions assumed vertical and of standing-wave character, are studied with the aim of accounting for the 5-minute oscillations recently discovered. For such waves the photosphere is found to provide an effectively solid bottom, while the corona can provide a free, largely reflective surface. The temperatures and depths in the chromosphere required to fit the observed period are not in discord with other evidence for the chromospheric temperature profile. (auth)

24205 HEATING OF THE SOLAR CORONA BY GRAVITY WAVES. William A. Whitaker (Air Force Special Weapons Center, Kirtland AFB, N. Mex.). Astrophys. J., 137: 914-30(Apr. 1, 1963).

A new type of hydrodynamic-wave heating is proposed for the solar corona. It is shown that internal gravity waves are preferentially generated by the convection zone and are easily transmitted to the corona. Acoustic waves with frequency characteristic of the photospheric granules cannot be transmitted through the reversing layer. The gravity waves are shown to dissipate by thermal conduction in the corona. A model is derived giving a 10^6°K corona. The sensitivity of this model to various assumptions is demonstrated. It is stable against small disturbances, but large instabilities may grow in the presence of a vertical magnetic field, leading to the formation of coronal streamers and a hoselike solar wind. (auth)

24206 EXCITATION OF CHROMOSPHERIC He I. R. Grant Athay (Univ. of Colorado, Boulder). Astrophys. J., 137: 931-44(Apr. 1, 1963).

New calculations are carried out for population of energy levels for the singlet and triplet states of He I, using corrected transition rates from an earlier analysis. The new results differ considerably from earlier calculations and lead to a new chromospheric model, whose major changes are in the geometry of the helium regions. Chromospheric emission observed at the limb at heights above 1000 km is largely confined to spicules with electron densities, n_e, of the order of $10^{11}-10^{12}$. Helium regions are identified as hot shells, having electron temperatures, $T_e \approx 5 \times 10^4$, encasing colder spicule cores. Interspicule regions must have $n_e \lesssim 3 \times 10^{10}$ and $T_e \gtrsim 3 \times 10^4$. This new model is consistent with radio data at millimeter wavelengths and is similar to that proposed by Moriyama. (auth)

24207 THE LOWER SOLAR CORONA: INTERPRETATION OF THE ULTRAVIOLET SPECTRUM. Stuart R. Pottasch (Inst. for Advanced Study, Princeton, N. J. and Indiana Univ., Bloomington). Astrophys. J., 137: 945-66 (Apr. 1, 1963).

An analysis of the resonance lines of nine elements (27 ions) formed in the chromosphere and corona of the sun yields the following results: the chemical composition of this region of the sun can be determined, without any knowledge of the detailed temperature-density structure in this region; a further clue concerning the detailed structure of this region may be obtained. A prediction of the expected emission of the sun in radio frequencies can be used both as a check on the correctness of the analysis and as a means of obtaining the ratio of the observed elements to hydrogen. (auth)

24208 SOME LIMITS ON THE EFFECT OF CORONAL SELF-EMISSION ON THE EXCITATION STATE OF CORONAL IONS. Charlotte Pecker and Richard N. Thomas (Institut d'Astrophysique, Paris and Joint Inst. for Lab. Astrophysics, Boulder, Colo.). Astrophys. J., 137: 967-80 (Apr. 1, 1963).

The effect of self-emission in some of the resonance lines of coronal ions is investigated. Limits are set on the optical thickness of the corona and upper chromosphere for ions of ionization state exceeding He II. A value $\gtrsim 10^4$ for the range of ions and range of conditions from normal atmosphere to coronal condensations is obtained. With this limit on τ, it is shown that mimicking the ionic configuration by that of a two-level atom sets an upper limit on the built-up radiation field. The atmospheric model and the solution to the transfer equation for a two-level atom is approximated with very small ϵ, to compute the relation between this upper limit on radiation field and τ_1, the optical thickness of the atmosphere. It is concluded that $\tau_1 \gtrsim 10$ is necessary to produce an observable effect on the line; and thus that the C–N–O–Si group in the undisturbed atmosphere is the most useful set of ions for more detailed investigation. In coronal condensations, other ions may possibly be used. (auth)

24209 ON THE EARLY HISTORY OF THE SUN AND THE FORMATION OF THE SOLAR SYSTEM. H. Alfvén (Royal Inst. of Tech., Stockholm). Astrophys. J., 137: 981-90(Apr. 1, 1963).

From a study of the satellite groups an empirical relation was derived, that makes it possible to find the rotational velocity of a central body when the mass distribution of the secondary bodies is known. This result is applied to the terrestrial planets. It appears that when the Mercury-Venus-earth group was formed, the rotational period of the sun was about 20 days. As this agrees reasonably well with the present value, it is tempting to conclude that the terrestrial planets were formed after the giant planets, at the formation of which the sun lost most of its angular momentum. However, arguments are given for the alternative view that the terrestrial planets were formed before the giant planets and that both processes took place when the sun was in the deuterium-burning state. If this alternative is accepted, we can calculate the present period of the solar axial rotation in good agreement with the observed value. (auth)

24210 THE DETECTION OF STARS WITH NEUTRON CORES. Geoffrey Burbidge (Univ. of California, La Jolla). Astrophys. J., 137: 995-6(Apr. 1, 1963).

The gravitational red-shift of the spectral lines is considered as the only possible means to detect stars containing neutron cores, assuming that there are sufficient energy sources available to make the star bright enough to be detected at all. A star in this highly evolved state would contain energy enough to be detectable only for a limited time. (C.E.S.)

24211 SOLAR RADIO BURSTS IN RELATION TO FLARE IMPORTANCES. M. K. Das Gupta and D. Basu (Univ. of Calcutta). Astrophys. J., 137: 997-9(Apr. 1, 1963).

The association solar radio bursts over the frequency range 200 to 9400 Mc with solar flares of different importances is investigated. Percentage association is highest at a frequency of about 4000 Mc, except for 3^+ flares, in which the maximum association remains constant within the frequency range 1000–5000 Mc. Centimeter bursts are found to be more associated with flares of any importance than decimeter and meter bursts. (C.E.S.)

24212 EFFECT OF SOLAR ACTIVITY REGIONS ON THE INTERPLANETARY MAGNETIC FIELD. E. W. Greenstadt (Space Tech. Labs., Inc., Redondo Beach, Calif.). Astrophys. J., 137: 999-1002(Apr. 1, 1963).

A correlation between the solar activity regions and the Pioneer V interplanetary magnetic field measurements is presented for the months February through May, 1960. The usual 27-day coronal periodicity can be seen in this interval. The corresponding values of coronal index and field magnitude are plotted against each other and the ratio of the field over the index is 0.87. Plausibility of the correlation presented is strengthened by comparison of a more detailed version of spacecraft measurements with chromospheric conditions. (C.E.S.)

24213 ON THE EXISTENCE OF AN IONIZED LAYER ABOUT THE GALACTIC PLANE. F. Hoyle (St. John's Coll., Cambridge, Eng.). Australian J. Phys., 16: 1-7 (Mar. 1963).

The ratiofrequency spectrum observed in directions towards the galactic pole shows a maximum near 5 Mc/s. It seems unlikely that the synchrotron process responsible for the emission can give such a maximum and it is suggested that the observed fall in the flux density at lower frequencies is caused by absorption in an ionized layer parallel to the galactic plane. To avoid an excessive value of the calculated electron density, the kinetic temperature is taken as low as is consistent with the maintenance of ionization, about $10^{4\circ}$K. At this temperature the gas cannot fill the galactic halo but must form a layer along the galactic halo but must form a layer along the galactic plane, the layer having a half-width of the order of 10^{21} cm. The electron density is found to be about 0.1 cm^{-3} so that along a line of sight to the galactic pole there are of the order of 10^{20} electrons. The mass of the layer is $\sim 5 \times 10^8 M_\odot$ and its rate of radiation in the Balmer continuum is $10^7 L_\odot$. The radiation rate per unit volume is $\sim 10^{-26}$ erg cm^{-3} s^{-1} in the Balmer continuum and the total radiation rate is $\sim 5 \times 10^{-26}$ erg cm^{-3} s^{-1}, a value close to the average emission of ionizing radiation by O and B stars. (auth)

24214 SOLAR DECIMETRE RADIO BURSTS. R. F. Mullaly (Commonwealth Scientific and Industrial Research Organization, Chippendale, New South Wales) and T. Krishnan. Australian J. Phys., 16: 8-23(Mar. 1963).

High resolution studies (2′ of arc beam) were made with the east-west arm of the Christiansen radio interferometer for about 50 21-cm solar burst-events during 1958-1961. The burst sources were always closely associated in position with already existing radio plage regions of the Sun's slowly varying decimeter radiations. They had sizes of from 2 to 5′ of arc, never exceeded but often approached in size their parent plage region, and showed no major movements during their development. Brightness temperatures ranged up to $2 \times 10^{9\circ}$K (mostly between 10^7 and $10^{8\circ}$K). More bursts were observed near the Sun's center than near the limb, and more on the western than on the eastern half. There was also a curious gap of 30° longitude on the eastern half of the Sun with virtually no burst activity. (auth)

24215 THE DIRECTIONS OF AURORAL RAYS. K. D. Cole (Dept. of External Affairs, Melbourne). Australian J. Phys., 16: 32-9(Mar. 1963).

The geometry of the radiation point of an auroral corona is examined. The radiation point of two rays is the antidirection of the point within the Earth at which the rays meet or appear to meet. It is therefore incorrect to identify the radiant point of a corona with local auroral zenith. Their difference in direction is commonly 0.5° of zenith distance. The importance of rays as magnetic disturbance indicators in the height range 100-1000 km is stressed, particularly in view of possible deformations of the magnetosphere whose full effects may not be estimated from ground-based observations of the geomagnetic field. (auth)

24216 EQUILIBRIUM MODELS OF STARS COMPOSED OF PURE HELIUM. R. Van der Borght and S. Meggitt (Australian National Univ., Canberra). Australian J. Phys., 16: 68-73(Mar. 1963).

Nine equilibrium models of pure helium stars were calculated for a range of 1 to 17 solar masses. It is shown that for stars larger than two solar masses radiation pressure cannot be neglected. The main effects are a marked reduction in luminosity and a larger core. The change in luminosity does not alter the main sequence line in the Hertzsprung-Russell diagram, but shifts the masses down along this line. There is a small decrease in radius accompanied by a corresponding increase in central density. (auth)

24217 THE RADIO EMISSIONS FROM JUPITER AND THE DENSITY OF JOVIAN EXOSPHERE. G. R. A. Ellis (Univ. of Tasmania, Hobart, Australia). Australian J. Phys., 16: 74-81(Mar. 1963).

The properties of cyclotron radiation from bunches of electrons trapped in a Jovian exosphere are discussed. It is shown that, if the polar magnetic field intensity is 15 gauss and the magnetic axis is inclined 10° to the rotation axis, the calculated properties agree with those observed for the decametric radiation providing Jupiter is surrounded by an extensive exosphere. The electron density of the exosphere varies mainly as the magnetic field intensity and at $1.5R_J$ is equal to $10^3/cm^3$. (auth)

24218 A SKY SURVEY OF NEUTRAL HYDROGEN AT λ 21 CM. II. THE DETAILED DISTRIBUTION OF LOW VELOCITY GAS. R. X. McGee, J. D. Murray, and Janice A. Milton (Commonwealth Scientific and Industrial Research Organization, Chippendale, New South Wales, Australia). Australian J. Phys., 16: 136-70(Mar. 1963).

The distributions of intensity and radial velocity of neutral hydrogen gas of low radial velocity are presented in the form of detailed diagrams of T_{max} the temperature at the peak of a hydrogen line profile, and of the radial velocity value at the T_{max}. The survey, concerning the whole sky from –90° to +42° in declination, was made with an aerial beam of 2.2° to half power and a multichannel receiver of bandwidth 38 kc/s and channel separation 33.2 kc/s (= 7.0 km/s in radial velocity). The radial velocities in the galactic plane are discussed in terms of differential galactic rotation and compared with results from optical interstellar absorption lines. General comparisons are made between the neutral hydrogen and distributions of continuum radio sources, H II regions, and dark nebulae and obscuration. (auth)

24219 SOME MEASUREMENTS OF THE IRREGULARITIES GIVING RISE TO RADIO-STAR SCINTILLATIONS AT THE EQUATOR. J. R. Koster (Univ. of Ghana, Legon). J. Geophys. Res., 68: 2579-90(May 1, 1963).

Equatorial radio-star scintillations are shown to have maximums near the equinoxes. Measurements on summertime irregularities show them to be elongated along the geomagnetic field, with an axial ratio of 7.5 or greater. Transverse sizes are of the order of 0.5 km. Velocities of drift are normally from west to east at night, with a mean value of 75 m/sec. The pattern on the ground drifts with remarkably little change. Velocity decreases with time of night, and the pattern size on the ground increases. (auth)

24220 HYDROGEN, HELIUM, AND HEAVY NUCLEI FROM THE SOLAR EVENT ON NOVEMBER 15, 1960. S. Biswas, C. E. Fichtel, D. E. Guss, and C. J. Waddington (National Aeronautics and Space Administration, Greenbelt, Md.). J. Geophys. Res., 68: 3109-22(May 15, 1963).

The flux and energy spectrums of solar hydrogen, helium, and heavy nuclei produced by the 3^+ solar flare on November 15, 1960, were measured in nuclear emulsions recovered from three rocket flights from Fort Churchill, Canada, at 42, 52, and 74 hours after the onset of the flare. The results are compared with similar measurements from two rocket flights during the November 12, 1960, solar cosmic-ray event and one during the September 3, 1960, event. It was found that the helium and medium nuclei had similar energy spectrums, steeper than those of protons in the energy interval from about 30 to 130 Mev/nucleon. The rigidity spectrum of hydrogen, helium, and medium nuclei was similar within experimental errors. The relative abundances of He, C, N, O and heavier nuclei were the same within the uncertainties each time a measurement was made. The average ratio of the helium to medium nuclei is 60 ± 7. The composition of these nuclei is similar to that of the solar atmosphere but significantly different from that of the galactic cosmic rays. The time dependence of the ratios of the protons to helium nuclei and protons to medium nuclei is compared with the predictions of the models for the solar particle propagation of Parker and Gold. The experimental results are found to be consistent with a general diffusion model having strong scattering centers in the inner solar system and a boundary region consisting of progressively weaker scattering centers at large distances from the sun. The data can be interpreted as indicating that the diffusion coefficient is mainly velocity-dependent during the early part of the event, normally the first day or so, whereas at later times it is also a function of rigidity. (auth)

24221 HIGH-RESOLUTION STUDIES OF TYPE III SOLAR EMISSION AT 11.4-METER WAVELENGTH. W. C. Erickson (General Dynamics/Astronautics, San Diego). J. Geophys. Res., 68: 3169-79(May 15, 1963).

Enhanced solar radio emission was observed during May and June 1962 at a wavelength of 11.4 meters (26.3 Mc/s) by the Clark Lake antenna. Two emission regions were observed. They were of large angular size, fluctuated rapidly in amplitude, and appeared to rotate with the sun and to be located at distances of about 2.0 and 2.5 solar radii from the sun's center. Correlation with swept-frequency data indicates that most or all of the observed emission was of spectral type III. On the basis of these data, plasma levels corresponding to densities of 8.5×10^6 electrons/cm^3 are estimated to be at heights of 2.0 and 2.5 solar radii over the active regions. These estimates agree well with the coronal streamer model of Newkirk. The average brightness distribution of one of the emission regions is found to be consistent with the core and halo model proposed by Weiss and Sheridan. (auth)

24222 TYPE IV RADIATION FROM FLARES COVERING SUNSPOTS. J. M. Malville (Univ. of Michigan, Ann Arbor) and S. F. Smith. J. Geophys. Res., 68: 3181-5 (May 15, 1963).

The obscuration of sunspot umbras by 44 flares of importance 2 or greater is investigated by superimposing Lockheed H_α photoheliograms on Mt. Wilson sunspot drawings. The percentage of the total umbral area of a sunspot group covered by a flare is found to be related to the intensity of the associated 2800-Mc/s burst and to the occurrence of meter-wave type IV radiation. (auth)

24223 SUDDEN FREQUENCY DEVIATIONS INDUCED BY SOLAR FLARES. K. L. Chan and O. G. Villard, Jr. (Stanford Univ., Calif.). J. Geophys. Res., 68: 3197-3224 (May 15, 1963).

The sudden frequency deviation (SFD), an effect induced on high-frequency radio waves by solar flares, is studied in detail. The method of identifying and analyzing SFD's and related theories on absorption, recombination, and the shape of SFD's is described. More than 5200 hours of continuous and simultaneous recordings of the instantaneous frequencies of four long-distance stable-frequency transmission paths were used. The percentage of solar flares accompanied by SFD's is a function of the size of the solar flare and the solar zenith angle, but does not show dependence on the season of the year or the heliographic location of the solar flares. The maximum amplitude of a SFD usually precedes that of an optical solar flare for large flares and lags for subflares. The several peaks in a SFD are interpreted as due to successive energy outbursts from the sun during a solar flare. The period between successive bursts varies from $\frac{1}{2}$ to 4 minutes, the average interval being 2 minutes. From the recombination time constant of the enhanced ionization and the change of absorption of the received signal, the enhanced ionization is estimated to occur between 120 and 200 km in the ionosphere. SFD's are found to be well correlated with centimeter-wave impulsive bursts of high intensity, meter-wave fast-drift bursts, and high-energy x-ray bursts, all of which usually occur during the first phase of solar flares. With respect to duration, recovery time constant, time of maximum, and height of enhanced ionization, SFD's are distinguished from other flare-associated ionospheric effects on radio waves, such as SID's, SCNA's, SEA's, and SPA's, all of which usually occur during the second phase of solar flares. (auth)

24224 COOPERATIVE PHENOMENA IN STELLAR DYNAMICS. P. A. Sweet (Univ. of Glascow). Monthly Notices Roy. Astron. Soc., 125: 285-306(1963).

The dispersion relations for small amplitude waves in systems of gas and stars in relative motion are derived by methods developed for plasma physics, the interstellar gas being treated as a hydrodynamic fluid and the stars as a collisionless gas. The classical Jeans' minimum wavelength for instability in a gas is fundamentally reduced by relative motion of the gas and stars. In the solar neighborhood star-streaming renders the gas unstable at all wavelengths, and is a possible cause of the turbulence in the interstellar gas. (auth)

24225 THE AUTOMATIC COMPUTATION OF SOLAR ATMOSPHERIC ABUNDANCES: CARBON ABUNDANCE. M. Andrews and D. Mugglestone (Univ. of Queensland, Brisbane). Monthly Notices Roy. Astron. Soc., 125: 347-65(1963).

The determination of the abundances of elements in the solar photosphere by the analysis of the Fraunhofer spectrum is presented. A description is given of methods suitable for the automatic computation of such abundances using the strong line formula developed by Faulkner and

Mugglestone. Some digital computer programs using these methods are reported, and the results thus obtained for the abundance of carbon, using the lines of the neutral element, are presented. (auth)

24226 CHARGED BOSE GAS IN ASTROPHYSICS. B. W. Ninham (Univ. of New South Wales, Kensington, Australia). Phys. Letters, 4: 278-9(May 1, 1963). (In English)

The existence of an ideal charged Bose gas in stellar systems is suggested; conditions that would exist in such an assembly of ions and relativistic electrons and positrons are examined; and astrophysical phenomena perhaps explicable on the basis of Bose-Einstein condensation are discussed. (D.C.W.)

24227 ULTRA-VIOLET EMISSION FROM THE SUN. B. E. J. Pagel (Royal Greenwich Observatory, Eng.). Planetary Space Sci., 11: 333-53(Apr. 1963).

Rocket observations of the ultra-violet and x-ray spectrum of the Sun are reviewed, together with discussions of the results from the viewpoint of solar physics. The ultraviolet spectrum was observed in detail down to 80 Å, while so far only non-dispersive measurements of the x-ray region are available. The spectrum resembles the normal Fraunhofer spectrum down to 2085 Å; below this limit absorption lines weaken, disappearing altogether at 1550 Å, and chromospheric and coronal emission lines appear (especially the Lyman series and resonance lines of He and He^+), superimposed on a faint continuum of chromospheric origin. X-ray emission below 100 Å is subject to both short-term and long-term variations, becoming both stronger and harder at times of solar activity. A number of data are tabulated and their significance for the determination of the solar atmospheric model is commented on. (auth)

24228 DOPPLER SHIFTED CYCLOTRON GENERATION OF EXOSPHERIC VERY-LOW-FREQUENCY NOISE ("HISS"). R. L. Dowden (Univ. of Tasmania, Hobart, Australia). Planetary Space Sci., 11: 361-9(Apr. 1963).

Cyclotron radiation from a receding electron in the exosphere can be doppler shifted to a frequency much less than the local gyrofrequency. A discrete bunch of electrons produce a discrete emission. A stream of electrons produce band limited while noise or hiss. The low frequency limit of this band is an emission cut-off and the upper limit is a propagation cut-off. Narrow, wide, and very wide bands of hiss can be produced by electron streams of even very broad velocity and pitch distribution. Tests of this theory and of the traveling wave tube theory are suggested. (auth)

24229 HYDROGEN IN GALAXIES. Morton S. Roberts. Sci. Am., 208: 94-100; 102; 104; 106(June 1963).

Recent studies with radiotelescopes indicate that the amount of interstellar hydrogen in a galaxy is correlated with its structural type and holds clues to its origin and evolution. Findings indicate that in spiral galaxies such as our own about 1% of the total galactic mass is in the form of interstellar hydrogen. In galaxies with more open spirals the hydrogen content runs as high as 14%, and some galaxies with an irregular structure contain as much as 30%. It is postulated that galaxies are endowed with different structures from the time of formation and change little with the passage of time. (C.H.)

Cosmic Radiation

Refer also to abstract 23684.

24230 (DCAS-TDR-62-191) SPACE PHYSICS PROGRAM: SECONDARY PAYLOAD PARTICLE RADIATION EXPERIMENTS FOR PROGRAM 622A SATELLITES. Semiannual Technical Note, January 1—June 30, 1962. (Aerospace Corp. Space Physics Lab., El Segundo, Calif.). Sept. 14, 1962. Contract AF04(695)-69. 4p. (AD-286852; TDR-69(2260-20)TN-1)

Experimental techniques were developed for measuring the flux and energy spectra of particle radiations in space as a function of position and time. A five-experiment package consisting of an omnidirectional proton spectrometer, high- and low-energy proton spectrometers, an electron spectrometer, a total energy detector, and a pulse height analyzer is briefly discussed. (D.C.W.)

24231 (UCRL-6693) NEAR-EARTH CHARGED-PARTICLE BACKGROUNDS MEASURED WITH POLAR ORBITING SATELLITES. F. D. Seward and H. N. Kornblum, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 25, 1963. Contract W-7405-eng-48. 41p.

In 1961 a detector system consisting of two scintillation counters, each sensitive to charged particles in different energy ranges was flown on four satellites. Counting rates as a function of satellite position are presented for both of these counters. Primary cosmic rays of very high energy were seen. These exhibit a latitude effect, with the flux reaching a maximum over each magnetic polar region. This maximum has the form of a plateau of about 30° radius. The shape of both the northern and southern plateau is not circular and is determined by the earth's magnetic field. The shape of these cosmic ray plateaus as measured in September, 1961 is illustrated. Two regions of high counting rate were observed at an altitude of about 400 km over the South Atlantic. It is shown that these correspond to the edges of the inner and outer radiation belts. By comparing these data with counting rates of other detectors aboard these flights, it is shown that the edge of the inner belt contains a penetrating component (high-energy protons) and the edge of the outer belt consists of much softer radiation. It is compatible with our data that the edge of the outer belt consists mostly of electrons of energies <5 Mev and >100 kev (the lowest energy detectable with our counter). This electron spectrum becomes softer with increasing latitude. Counting rates of the detector sensitive to low-energy particles were observed to fluctuate rapidly and irregularly in a region surrounding each magnetic pole. This region corresponds to the visible auroral zone. Evidence is presented showing that this radiation consists of low-energy electrons traveling so that they will enter the earth's atmosphere. (auth)

24232 (T-373R) "EARTH STORMS" AND THE GEOPHYSICAL ASPECTS OF COSMIC RADIATION. V. A. Troyickaya. Translated by E. R. Hope (Defence Research Board, Can.) from Vestn. Akad. Nauk SSSR, [No.] 3, 51-5 (1962). 5p. (AD-282048)

Some of the more significant findings on geomagnetic storms and geophysical aspects of cosmic radiation reported at a series of conferences are reviewed. Information on auroral storms, geomagnetic storms, variations of cosmic radiation, and correlation of cosmic ray events with storms is presented. Theory of magnetic storms was also considered. (D.C.W.)

24233 THEOREMS CONCERNING THE ALLOWED CONE OF COSMIC RADIATION. Ernest C. Ray (National Aeronautics and Space Administration, Greenbelt, Md.). Ann. Phys. (N. Y.), 22: 94-101(Apr. 1963).

A previous investigation of the cosmic ray shadow cone and low latitude main cone is extended to include the main cone at all higher latitudes. The results are embodied in two theorems that specify the nature of a boundary of a

class of trajectories, none of which are forbidden. No numerical results are included. (auth)

24234 X-RAYS FROM OUTSIDE THE SOLAR SYSTEM. F. Hoyle (Cambridge Univ., Eng.). Astrophys. J., 137: 993-5(Apr. 1, 1963).

A bremsstrahlung process is presented as a possible explanation for the origin of an isotropic flux of x rays of energy ~4 kev recently discovered. The x rays originate outside the solar system. The bremsstrahlung are produced by electrons with energies upward of ~5 kev. Results suggest that this bremsstrahlung process occurs outside the galaxy. (C.E.S.)

24235 INFORMATION THAT ISOTOPIC MEASUREMENTS PROVIDE ABOUT SPACE AND THE COSMOS. O. A. Schaeffer (Brookhaven National Lab., Upton, N. Y.). J. Chim. Phys., 60: 332-8(Jan.-Feb. 1963). (In English)

The study of the isotopic abundances of the rare gases helium, neon, and argon in iron meteorites lead to the conclusion that the rare gases are produced mainly by the action of the cosmic rays with the meteorites. The high energy cosmic ray particles produce nuclear spallation reactions with the elements composing the meteorites. By comparing the cosmic-ray produced radioactive isotopes of different half lives such as H^3, Ar^{37}, Ar^{39}, Cl^{36}, Al^{26}, Be^{10}, and K^{40} it is possible to investigate the constancy of cosmic rays in time and space. The measurements indicate that during the last 500,000 years there was no greater than a 10% change in the intensity of cosmic rays, and that cosmic rays near the earth have about the same intensity as cosmic rays in the asteroidal belt some 450 million kilometers further from the sun. In addition there is evidence that indicates that some of the meteorites have undergone collisions in space previous to being captured by the earth. (auth)

24236 MEASUREMENT OF COSMIC RAY ALBEDO NEUTRON FLUX ABOVE THE ATMOSPHERE. J. P. Martin (RIAS, Baltimore), L. Witten, and L. Katz. J. Geophys. Res., 68: 2613-18(May 1, 1963).

A pair of neutron counting systems was carried on a ballistic flight path on a pod flown pickaback on an Atlas rocket on December 19, 1961. One system detected the fast neutron flux, the other detected slow neutron density. Measurements of albedo neutrons were made between 480 and 1000-km altitude. The pod entered the trapped radiation belt in the vicinity of 1000 km altitude and 27° north geomagnetic latitude. The albedo neutron results from both systems are consistent with the flux calculations of Hess, Canfield, and Lingenfelter. The flux measurements agree with the measurements of Hess and Starnes. Differences between the results of the density measurements and those made by Reidy, Haymes, and Korff can be adequately accounted for by the different experimental conditions under which the measurements were made. A low-altitude increase in the density count rate suggests that some low-energy trapped protons are found beginning at a lower altitude than the higher-energy trapped protons. (auth)

24237 OBSERVATIONS ON THE SOLAR PARTICLE EVENTS OF JULY 1961. D. E. Guss and C. J. Waddington (National Aeronautics and Space Administration, Greenbelt, Md.). J. Geophys. Res., 68: 2619-25(May 1, 1963).

The spectrum of solar protons with energies between 77.5 and 290 Mev was measured during the flare event of July 12, 1961, by means of nuclear emulsions flown on a high-altitude balloon. The differential spectrums averaged over the period from 0839 to 1819 UT, July 13, are consistent with a power law of kinetic energy with an exponent $\gamma = 5.6 \pm 0.3$, a power law of total energy over rest energy with $\lambda = 47 \pm 3$, and an exponential law of rigidity with $P_0 = 52 \pm 3$. The intensity of particles with $E \geq 77.5$ Mev = 1.69 ± 0.14 p/cm^2 ster sec. During the solar particle event of July 18 the intensity of particles with $E \geq 100$ Mev was 40 ± 8 p/cm^2 ster sec in the time interval from 1305 to 1918 UT, July 18. The similarity between these events and those of April 29 and May 4, 1960, is noted. (auth)

24238 GEOMAGNETICALLY TRAPPED PROTONS WITH ENERGIES GREATER THAN 350 Mev. Gordon Garmire (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res., 68: 2627-38(May 1, 1963).

The intensity and pitch-angle distribution of geomagnetically trapped protons with energies greater than 350 Mev were determined by means of data received from a Cherenkov detector on board Explorer 11. Analysis of the data reveals that the contours of constant counting rate rise more rapidly in altitude with increasing latitude than do the contours at a threshold energy of 43 Mev. The scale height of the high-energy protons along a magnetic field line is found to be significantly greater than the scale height of the lower-energy protons. The first of these results is consistent with a breakdown of the transverse adiabatic invariant J, which tends to steepen the proton energy spectrum with increasing geomagnetic latitude and altitude, assuming cosmic ray albedo neutrons to be the source of these protons. The assumptions concerning the breakdown of the invariance of J are justified through detailed numerical calculations of proton trajectories in both a dipole magnetic field and the Finch and Leaton approximation to the geomagnetic field. The second result is not consistent with the cutoff energy dependence obtained by trajectory calculations and the approximate constancy of the neutron albedo injection coefficient along a magnetic field line. The average atmospheric density $\bar{\rho}$ and energy losses $(\overline{dE/dt})$ along a magnetic field line as a function of energy were investigated. It is found that the variations of the scale heights of $\bar{\rho}$ and $(\overline{dE/dt})$ are much less than the observed variation of the scale height of the radiation as a function of energy. (auth)

24239 SPACE-TIME ASSOCIATION OF AURORAL GLOW AND X RAYS AT BALLOON ALTITUDE. K. A. Anderson (Univ. of California, Berkeley) and R. DeWitt. J. Geophys. Res., 68: 2669-75(May 1, 1963).

A space-time association between a widespread auroral glow over Alaska and x rays at balloon altitude on March 5, 1962, was observed. It is estimated that electrons above 25 kev contribute about 1 per cent of the luminous excitation on this occasion. (auth)

24240 SIMULTANEOUS ELECTRON PRECIPITATION IN THE NORTHERN AND SOUTHERN AURORAL ZONES. R. R. Brown, K. A. Anderson, C. D. Anger, and D. S. Evans (Univ. of California, Berkeley). J. Geophys. Res., 68: 2677-84(May 1, 1963).

During simultaneous high-altitude balloon flights from College, Alaska, and Macquarie Island, Australia, on March 5, 1962, substantial fluxes of auroral zone x rays were observed in both hemispheres during magnetic bay activity. The x-ray observations indicate that the electron influx in both hemispheres extended over a region 3° in latitude and 16° in longitude. The near equality of the x-ray fluxes in both auroral zones suggests that the electron precipitation originated from processes far out on the lines of force, near the equatorial plane. The magnetic and ionospheric disturbances accompanying the x-ray event are discussed. (auth)

24241 THE ELECTRON DENSITY DISTRIBUTION IN THE F_2 LAYER OF THE IONOSPHERE IN WINTER. J. O.

Thomas (Stanford Univ., Calif.). J. Geophys. Res., 68: 2707-18(May 1, 1963).

The winter daytime enhancement of ionization observed under certain circumstances in the F region of the ionosphere is described. The existence and magnitude of this region of enhanced ionization depends strongly on latitude and on the solar cycle epoch. This relation of the ionization enhancement with the well-known winter anomaly, and a possible production process are discussed. The evidence seems to point to a downward flux of electrons from above the peak of the F_2 layer as the most likely cause of the winter spur. (auth)

24242 THE MOTION OF LOW-RIGIDITY COSMIC RAYS IN THE EARTH'S MAGNETIC FIELD AND THE EFFECTS OF EXTERNAL FIELDS. William R. Webber (Univ. of Minnesota, Minneapolis). J. Geophys. Res., 68: 3065-85(May 15, 1963).

A general approach is made to the discussion of motion of low-rigidity cosmic rays in a dipole field; it rests on the characteristics of the motion of these particles in the Alfvén regime and a family of trajectories passing near the origin of the dipole itself. The general rigidity range of applicability of the method is discussed. It is found that within this range of applicability the asymptotic directions of the particles outside the geomagnetic field may be determined for a wide range of arrival latitudes and arrival directions with respect to the vertical without resorting to the numerical integration of trajectories. The presentation is extended to the real geomagnetic field; asymptotic directions applicable to certain locations are presented and discussed for solar-flare particles and galactic variations detected by neutron monitors as well as lower-rigidity particles detectable only at balloon and satellite altitudes. Finally, the effects of external fields on the asymptotic directions are discussed, and the asymptotic directions appropriate to the arrival of solar-flare particles as detected by neutron monitors at sea level in the presence of ring currents are presented. (auth)

24243 PARTICLE INFLUX AT HIGH LATITUDES. I. TEMPORAL AND LATITUDE VARIATIONS. J. B. Gregory (Univ. of Canterbury, Christchurch, N. Z.). J. Geophys. Res., 68: 3087-96(May 15, 1963).

An analysis of ionosonde f_{min} data for 1960 from geomagnetic latitudes above 40°N and S reveals simultaneous variations in time series of 5-day averages. The effect is ascribed to continuous influx of particles, mainly solar protons, that are a more important ionizing agency below 100-km altitude at high latitudes than solar wave radiation. During quiet periods cosmic radiation varies inversely as the particle influx. Radiation belt precipitation appears to contribute little to the influx at higher latitudes. (auth)

24244 PARTICLE INFLUX AT HIGH LATITUDES. 2. SOLAR PROTONS. J. B. Gregory (Univ. of Canterbury, Christchurch, N. Z.). J. Geophys. Res., 68: 3097-3107 (May 15, 1963).

Solar proton events smaller than those previously recognized were detected by means of high-sensitivity backscatter sounding of the lower ionosphere at 79°S geomagnetic. Ionosonde f_{min} data from high-latitude stations confirm these events. For 1960, 37 events are tabulated, including 13 already known. The total duration of proton streams during 1960 was not less than 167 days. Particle influx, including protons, was effective as an ionizing agency at high latitudes for more than 60 per cent of that year. (auth)

24245 COSMIC-RAY INTENSITY DISTRIBUTIONS AT 640 GRAMS PER SQUARE CENTIMETER ATMOSPHERIC DEPTH AROUND CAPE TOWN. N. F. du Plooy, G. J. Kuehn, J. P. Maree, P. H. Stoker, and A. J. van der Walt (Potchefstroom Univ. for C.H.E., South Africa). J. Geophys. Res., 68: 3123-30(May 15, 1963).

Worldwide surveys on the nucleon component intensity distributions of cosmic radiation showed consistent results with the calculations of vertical magnetic cutoff rigidities both by Rothwell and by Quenby and Wenk. The calculations of Quenby and Wenk are the least accurate in a region over the North Atlantic, where Pomerantz and Agarwal found the theoretical cutoff rigidities too low by as much as 2 Bv, and in a region around Cape Town, for which Pomerantz and Agarwal found consistent results for a crossing at fairly low latitude. The higher-latitude region around Cape Town was investigated by an airborne standard neutron monitor at 640 g/cm^2, and the lines of equal cosmic-ray intensities were compared with the lines of equal cutoff rigidities calculated according to the geomagnetic theories of Störmer, Rothwell, and Quenby and Wenk. Close agreement was found with the theory of Quenby and Wenk, and compatibility with other theories is excluded statistically within 90 per cent confidence limits. The intensity-latitude curve along 18°35'E geographic longitude showed no knee effect below 40.5°S geomagnetic latitude, whereas Kodama has found a knee at about 35.4°S at sea level. This is discussed in view of the Cape Town magnetic anomaly, but no explanation can be given of this controversial result. (auth)

24246 CHANGES IN THE STRUCTURE OF THE OUTER RADIATION ZONE ASSOCIATED WITH THE MAGNETIC STORM OF SEPTEMBER 30, 1961. W. G. V. Rosser (Univ. of Iowa, Iowa City). J. Geophys. Res., 68: 3131-48(May 15, 1963).

The arrival of solar protons on September 28, 1961, had no observable effect on the distribution and intensity of electrons in the outer radiation zone. After the magnetic storm of September 30, 1961, a turbulent solar plasma was observed beyond the limits of the outer radiation zone. The evidence presented suggests that the outer boundary of the geomagnetic cavity contracted during the period immediately after the storm owing to the arrival of excess solar plasma. On October 2, 1961, the radial extent of trapping extended beyond a geocentric distance of 80,000 km. It is suggested that this expansion of the geomagnetic cavity may be due to the presence of a diamagnetic ring current. After the magnetic storm the intensity of electrons >1.6 Mev detected by the 302 GM counter decreased by a factor of 1000 at L = 4.5. The counting rate of the 302 GM counter then increased slowly over a period of days, but had not returned to its prestorm value at L = 4.5 by October 6, 1961. (auth)

24247 THE EFFECT OF GEOMAGNETIC CROCHET ON COSMIC RAY INTENSITY. Constance S. Warwick (National Bureau of Standards, Boulder, Colo.). J. Geophys. Res., 68: 3303-4(May 15, 1963).

The sudden change in the geomagnetic field corresponding to an enhancement of currents flowing in the lower ionosphere is investigated. Both cosmic ray increase and this geomagnetic effect are associated with shortwave fadeout and an attempt is made to ascertain if they are causally related. It is found that the field change can not wholly explain the cosmic ray increase. (C.E.S.)

24248 CHANGES IN COSMIC RADIATION INTENSITY ASSOCIATED WITH SOLAR FLARES. B. G. Wilson and C. P. Nehra (Univ. of Alberta, Calgary). J. Geophys. Res., 68: 3305(May 15, 1963).

Solar flares accompanied by shortwave fadeout (SWF)

were studied. Geomagnetic crochets were positively correlated with fadeouts, about one SWF in three being associated with a crochet. (C.E.S.)

24249 AN EFFECT OF NONADIABATICITY ON THE STRUCTURE OF RADIATION BELTS. Satio Hayakawa and Haruo Obayshi (Nagoya Univ., Japan). J. Geophys. Res., 68: 3311-13(May 15, 1963).

Nonadiabaticity effects are investigated in connection with particle losses in the radiation belts. The steep change in atmospheric density with the variation of the altitude at which the particle is mirrored is taken into account. Canonical formalism and a perturbational treatment are applied. (C.E.S.)

24250 DOUBLE CORE EVENT IN EXTENSIVE AIR SHOWER. Saburo Miyake, Kensaku Hinotani, Tatsunosuke Kaneko, and Nobuo Ito (Osaka City Univ.). J. Phys. Soc. Japan, 18: 592-3(Apr. 1963).

An example of a double core event in an extensive air shower (EAS) whose size is 6×10^5 particles and age parameter is 0.8 is presented. Assuming pure electromagnetic development of EAS in the atmosphere, a crude estimate of initiation height is obtained from the age. From the initiation height a transverse momentum of 10 Bev/c is obtained. (C.E.S.)

24251 COSMIC-RAY LATITUDE KNEE AROUND CAPE TOWN ANOMALY. Masahiro Kodama (Inst. of Physical and Chemical Research, Tokyo). Nature, 198: 472-4(May 4, 1963).

The so-called cosmic-ray latitude knee around the Cape Town anomaly is much lower in the south direction from Cape Town than in other regions when observed at sea level. Results of 5 surveys of cosmic-ray intensity versus geomagnetic latitude indicate that neutron intensity at 35°S and above 50°S becomes larger as solar activity descends. Findings are compared with those from a latitude survey using an airborne neutron monitor performed around Cape Town. It is concluded that some anomalous effect in the primary cosmic-ray spectrum due to the strong geomagnetic anomaly is observable even at sea level. (C.H.)

24252 ELECTRONS AND PHOTONS IN COSMIC RADIATION. H. F. Jongen (Universiteit, Amsterdam). Ned. Tijdschr. Natuurk., 28: 65-70(Feb.-Mar. 1962). (In Dutch)

Experimental data on the presence of primary electrons and photons in the vicinity of the earth are briefly reviewed and summarized. (J.S.R.)

24253 PHOTONUCLEAR INTERACTIONS OF COSMIC MUONS IN HEAVY-LIQUID BUBBLE CHAMBERS. M. Paty (Ecole Polytechnique, Paris), A. Rousset, and K. Schultze. Nuovo Cimento (10), 28: 356-63(Apr. 16, 1963). (In English)

Interactions of cosmic mesons (μ) with nuclei in a heavy-freon bubble chamber were observed. These interactions were interpreted as occurring through the virtual photon field of the meson (μ). The angular distributions of the secondary mesons (μ) were measured. A photonuclear cross section of (120 ± 20) mb/nucleon was determined. (C.E.S.)

24254 ANISOTROPIES OF COSMIC-RAY JETS AND "EQUILIBRIUM" THEORIES OF MESON PRODUCTION. C. F. Gauld, C. B. A. McCusker, and L. S. Peak (Univ. of Sydney). Nuovo Cimento (10), 28: 444-5(Apr. 16, 1963). (In English)

The X factor for departure from isotropy in the CMS was determined by measuring experimental angles of meson emission in an emulsion exposed to cosmic proton jets. The X values were also computed for several energies and several tunnel lengths on the basis of Landau's shock-wave theory. The maximum value for a 10^{12} ev proton is 6, falling rather quickly to < 2 as the tunnel length increases. (C.E.S.)

24255 MOMENTUM MEASUREMENTS OF CHARGED PARTICLES IN A SINGLE GAP SPARK CHAMBER PLACED IN A MAGNETIC FIELD. A. I. Alikhanian, T. L. Asatiani, A. M. Matevosian, and R. O. Sharkhatunian (Physical Inst. of the State Committee on the Use of Atomic Energy, Erivan). Phys. Letters, 4: 295-8(May 1, 1963). (In English)

Preliminary measurements of the momenta of charged cosmic particles were made with a large single gap (21 to 50 cm) spark chamber in a magnetic field to determine the accuracy and the particle momentum-track curvature correspondence for such a device. The spark curvature was found to be caused by a true curvature of the particle track in the magnetic field. High accuracy is expected for particles of tens of Bev. (D.C.W.)

24256 EFFECT OF DROP IN SOLAR ACTIVITY ON INTENSITY OF COSMIC RAYS ACCORDING TO SOUNDING ROCKET MEASUREMENTS IN 1958 AND 1960. Yu. G. Shafer. Planetary Space Sci., 11: 427-30(Apr. 1963). (Translated by H. S. H. Massey from Iskusst. Sputniki Zemli, No. 13, p.85, 1962).

The intensity of cosmic rays was measured with sounding rockets to an altitude of 210 km at a period of solar activity drop. A comparison of the measurements obtained in 1958 and 1960 shows that the effect of the drop in solar activity on the intensity of primary radiation is 0.14 ± 0.04 particles $cm^{-2}sec^{-1}$. This corresponds to a 9.5% increase in intensity in 1960 when compared with the 1958 measurements, when solar activity was greater. (C.E.S.)

24257 SOFT PARTICLE RADIATION AT AN ALTITUDE OF 320 km IN THE LATITUDES NEAR THE EQUATOR. I. A. Savenko, P. I. Shavrin, and N. F. Pisarenko. Planetary Space Sci., 11: 431-6(Apr. 1963). (Translated by S. H. Massey from Iskusst. Sputniki Zemli, No. 13, p.75, 1962).

A comparison of the energy given off in a CsI(Tl) crystal of an outboard detector and the intensity recorded by an internal scintillation counter of a Soviet satellite is presented. Each passage through a radiation belt is accompanied by a considerable rise in the internal counting rate while passage over the equatorial region corresponds to a minima. The external detector has a maxima at the equatorial passage. This indicates the existence of intense fluxes of particle radiation at an altitude of ~300 km in equatorial latitudes between 150°E and 150°W. The radiation must be fairly soft since the internal shielded counter hardly detected it. (C.E.S.)

Criticality Studies

24258 (IG-Report-142) A COMPARISON OF A SIMPLE INTERACTION THEORY WITH EXPERIMENT. R. T. Ackroyd, E. J. Burton, and M. A. Perks (United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England). 1959. 36p.

A simple interaction theory is presented for calculating safe arrays of fissile units of arbitrary size, shape, and distribution. At every stage of the theory an endeavor was made to err on the side of safety. Mixed arrays of fast and thermal units are considered. The reflecting material and void present between units may be well defined, as for example in certain kinds of fissile store, or it can

be random as in plants where personnel and portable equipment may be in close proximity to vessels. The theory is compared, for the case of well defined reflectors and fissile units of one type, with the results of three interaction experiments made; on a pair of 20-kg spheres of uranium immersed in water, on arrays of similar spheres in a concrete vault, and for 3- and 7-unit arrays of cylinders containing aqueous solutions of uranyl fluoride. The theoretical results are generally more conservative than the experimental ones, but not to an unduly pessimistic degree. It is not feasible to test a novel feature of the theory, in that it can deal with the case of random or unknown distributions of reflecting material. Since the experiments for well-defined reflectors indicated that the assumptions of the theory do err on the side of safety, the predictions for random reflectors are considered to be conservative. These pitches are somewhat greater than those for well-defined reflectors, but the increases are insufficient to cause real difficulties in the design and cost of plant. To those dealing with large numbers of interaction problems the theory may prove to be attractive on four accounts. The good agreement obtained so far with experiment suggests that the theory is reasonably accurate. Unlike Monte Carlo methods, which in principle are more accurate, the method requires very little computation; (as many as thirty cases of an interaction problem can be dealt with in five minutes on a medium size computer such as Mercury). Unlike the interaction parameter method it does not require an experiment on a simple assembly of units in order to make a prediction for a complicated array of units. The theory makes predictions using the same core and reflector constants as employed in ordinary reactor calculations for single units. (auth)

24259 (NP-12249) RAPPORT DE SURETE D'UNE EXPERIENCE DE CRITICALITE SUR UNE SOLUTION DE PLUTONIUM ALECTO. (Safety Report of a Criticality Experiment on a Plutonium Solution. ALECTO). R. Caizergues, C. Clouet d'Orval, J, Kremser, and P. Verriere (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). [nd]. 103p. (EC.S No. 86)

The ALECTO experiment is for the study of the critical conditions of receptacles containing a Pu solution reflected by an infinite water reflector. The installation of this experiment is described in some detail. Theoretical calculations were made of the critical mass, reactivity effect of millimeters of solution, reactivity effect of safety elements, temperature coefficient, and safety of primary and secondary storage containers. The operation of the experimental installation, especially control apparatus and start-up and operational procedures, is described. The risks connected with an accidental reactivity introduction and a power excursion are then discussed. (J.S.R.)

Elementary Particles and Radiations

Refer also to abstracts 23626, 23631, and 23647.

24260 (AD-286667) POSITRON ANNIHILATION REACTIONS IN CONDENSED MATERIALS. Final Report, July 1, 1960–June 30, 1962. John D. McGervey (Western Reserve Univ., Cleveland). Contract AF49(638)-760. 5p.

Measurements were made of the time distribution of positron annihilations in aluminum, tin, copper, titanium, and zinc. All of the metals measured to date have shown a long lived component. This component, which is still unexplained, contains from 5 to 10% of the total counts, with a mean life of about 4×10 to the -10th power sec in all the metals measured. The presence of the long lived component is deduced from an extremely small number of counts. Nevertheless these counts are significantly above the background level; the counting rate in the peak was about 5000 times the background. Short mean lives in these metals were determined by subtracting the counts in the extrapolated long lived component and measuring the slope of the remaining distribution. Data are being obtained on the angular distribution of annihilation radiation from alloys. The angular correlation method gives a direct experimental determination of the Fermi energy of the conduction electrons. The major difficulty with the method is that in many alloys of interest a large number of positrons annihilate with core electrons rather than conduction electrons, and it is necessary to subtract this component in order to obtain the curve for conduction electron annihilation. (auth)

24261 (ARL-62-440) THE STRUCTURE OF FERMION DENSITY MATRICES. Technical Note No. 80. A. J. Coleman (Uppsala Univ.). June 1, 1962. Contract AF61(052)-351. 57p. (AD-286162)

A new approach is presented to the many-particle problem in quantum mechanics by proposing a method of finding natural orbitals and natural geminals of a system without prior knowledge of the wave functions. Necessary and sufficient conditions, under a variety of restrictions, are given under which an alleged one-particle density matrix is derived from an n-fermion system. (auth)

24262 (BNL-6324) INVARIANT SOLUTIONS OF THE EXACT BETHE-SALPETER EQUATION IN GENERAL-MASS CASE. Noboru Nakanishi (Brookhaven National Lab., Upton, N. Y.). July 16, 1962. Contract [AT(30-2)-Gen-16]. 21p.

The invariant solutions of the Bethe-Salpeter equation in an approximation that is more general than the ladder approximation are found in the case of non-zero exchanged-meson mass. They are expressed as series of "truncated vertex functions," which are certain combinations of the usual vertex functions. The eigenvalues of the coupling constant are determined by a transcendental equation, which is not solved explicitly. (auth)

24263 (BNL-6934) EMPIRICAL SYSTEMATICS OF THE PION-NUCLEON SYSTEM. K. F. Riley (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 13p.

Recent measurements of the total cross sections for π^+-p and π^--p interactions are presented and compared with existing pion-nucleon data. Systematic behavior noted in the occurrence of pion-nucleon system isobars and their quantum numbers is discussed. (D.C.W.)

24264 (JINR-P-1219) ROZHDENIE $\tilde{\Lambda}$-GIPERONOV OTRITSATELNYMI π-MEZONAMI S ENERGIEI 7-8 Bev NA VODORODE. ($\tilde{\Lambda}$-Hyperon Production by 7-8 Bev Negative Pions on Hydrogen). B. A. Belyakov, V. I. Veksler, N. M. Viryasov, et al. (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 6p.

It is reported that Λ-hyperon production and decay was observed. The magnitude of the cross section for Λ generation by 7–8 Bev π^- mesons on hydrogen was estimated to be $\approx 3\mu$b. (auth)

24265 (LNF-62/108) INTEGRALI NELLO SPAZIO DELLE FASI PER SISTEMI DI DUE E TRE PARTICELLE. (Phase Space Integrals for Two and Three Particles). Note No. 175. G. Sette (Italy. Comitato Nazionale per

l'Energia Nucleare. Laboratori Nazionali, Frascati). Dec. 20, 1962. 14p.

The derivation of phase space integrals for two and three particles in the barycenter system is shown. (J.S.R.)

24266 (LNF-63/22) CONNECTION AMONG PARITY STRANGENESS AND ISOTOPIC SPIN. Note No. 193. R. Gatto (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Apr. 13, 1963. 8p.

The possibility of a connection between parity conservation and conservation of isotopic spin and strangeness is examined by considering elementary particle models based on invariance under Lie groups. The models are considered as complete dynamical elementary-particle models in which interactions are formed out of currents generated in the model by the group invariance and in which the full invariance breaks down only in the physically significant solution of the invariant dynamic equations. The octet, Sakata, and G_2 model are considered, and parity conservation is found to imply conservation of isotopic spin and strangeness. Strangeness conservation conversely implies isotopic spin and parity conservation in the G_2 and Sakata models, while isotopic spin and strangeness conservation imply parity conservation in the octet model. (D.C.W.)

24267 (NYO-9290) EIGENFUNCTIONS FOR BARYON MESON CALCULATIONS IN THE OCTUPLET MODEL OF SU_3 SYMMETRY. Pekka Tarjanne (Carnegie Inst. of Tech., Pittsburgh). Mar. 1963. Contract AT(30-1)-882. 12p.

Explicit tables of eigenfunctions are presented for the simplest reductions (8×8, 8×10, 10×10, and $10 \times \overline{10}$) occurring in processes involving the baryon and meson octuplets and the isobar decuplet. (auth)

24268 (NYO-9290A) TABLES OF EXPLICIT EIGENFUNCTIONS FOR THE REDUCTIONS 8×8, 10×8, 10×10 AND $10 \times \overline{10}$ OF THE GROUP SU_3. Pekka Tarjanne (Carnegie Inst. of Tech., Pittsburgh). Apr. 1963. Contract AT(30-1)-882. 16p.

Generalized Clebsch-Gordan coefficients for the group SU_3 were calculated using a classical method. Relations are given between different generalized Clebsch-Gordan coefficients. Eigenfunctions with contracted isotopic spin compositions are given for the 8×8, 10×8, 10×10, and $10 \times \overline{10}$ reductions. (auth)

24269 (NYO-10241) PARASTATISTICS: EXPERIMENTAL SUGGESTIONS; CONNECTION WITH SPIN, AND TCP THEOREM, FOR A GENERAL FIELD THEORY. G. F. Dell'Antonio (Naples. Università. Istituto di Fisica Teorica), O. W. Greenberg (Maryland. Univ., College Park); and E. C. G. Sudarshan (Rochester, N. Y. Univ.). July 31, 1962. Contract AT(30-1)-875. 9p.

Use of a quantum field theory obeying parastatistics to treat free particles is further examined. Relativistic quantum field theories independent of locality are noted to hold for paralocal fields, and the TCP theorem is generalized to paralocal fields. The following generalization of the connection of spin and statistics is demonstrated: given the choice between parabose and parafermi statistics, integral spin fields must obey parabose, and odd half-integral spin fields must obey parafermi statistics. (D.C.W.)

24270 (NYO-10263) A NO INTERACTION THEOREM IN CLASSICAL RELATIVISTIC HAMILTONIAN PARTICLE DYNAMICS. John T. Cannon and Thomas F. Jordan (Rochester, N. Y. Univ.). May 8, 1963. Contract AT(30-1)-875. 38p.

A relativistically invariant classical mechanical hamiltonian description of a system of three (spinless) particles is shown to admit no interaction between the particles. If a set of ten functions of the canonical variables of the three particle system satisfies the Poisson bracket relations characteristic of the ten generators of the inhomogeneous Lorentz group, and—with the canonical position variables of the particles—satisfies the Poisson bracket equations that express the familiar transformation properties of the (time-dependent) particle positions under space translation, space rotation, and Lorentz transformation, then this set of ten functions can only describe a system of three free particles. A significant part of the proof is valid for a system containing any fixed number of particles. In this general case a simplified form is established for the hamiltonian and generators of Lorentz transformations, and it is shown that the generators of space translations and space rotations can be put in the standard form characteristic of free particle theories. The proof of the latter involves a generalization from one to many three-vector variables of the angular momentum Helmholtz theorem of Lomont, Moses, and Keller. (auth)

24271 (TID-16793) SOME EXTENSIONS OF THE BORN APPROXIMATION FOR PHASE SHIFTS. Roger F. Dashen (Sandia Lab., Albuquerque, N. Mex.). [Sept. 1962]. Contract [AT(29-1)-789]. 17p. (SCDC-2858)

A new approximation for phase shifts is derived using a method radically different from the usual Green's function techniques. It turns out to be a cross between the Born and WKB approximations and provides a powerful tool for investigating the behavior of the Born formula. In particular, the latter is shown to be valid for weak, long range potentials regardless of the phase shift magnitude. Several numerical examples are included. (auth)

24272 (TID-16908) A UNIFIED SELECTION RULE WITH SYMMETRY BETWEEN STRONG AND WEAK INTERACTIONS. K. Hiida (Argonne National Lab., Ill.). June 1962. Contract [W-31-109-eng-38]. 10p. (UAC-6599)

The Gell-Mann and Nishijima selection rule for electromagnetic and strong interactions is generalized to hold for weak interactions by introducing a unified selection rule. The introduction assumes that there is a symmetry between strong interactions and leptonic weak interactions; that the lepton number is always conserved; that there are four leptons in nature, namely, e and μ with unit charge but no strong interaction, and two different neutrinos without charge and without electromagnetic and strong interactions; and that the β-decay $n \rightarrow p + e^- + \nu$ occurs in nature. Consequences of the new selection rules are discussed. (D.C.W.)

24273 (UCRL-10584(Rev.)) AN APPROXIMATION METHOD FOR REGGE TRAJECTORIES AND ITS IMPLICATIONS ON THE SPIN-2 PARTICLE OF THE CHEW-FRAUTSCHI DIAGRAM. Akbar Ahmadzadeh and Ismail A. Sakmar (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 20, 1963. Contract W-7405-eng-48. 12p.

The Chew-Frautschi diagram indicates the existence of a spin-2 particle of about 50 m_π^2 mass on the Pomeranchuk trajectory, and such a particle at 80 m_π^2 has been observed. Application of a proposed approximation method for Regge trajectories to the Pomeranchuk trajectory, however, shows the 80 m_π^2 particle can not belong to the Pomeranchuk trajectory unless high-energy p-p scattering experiments have been misinterpreted or unless a generally accepted assumption is wrong. New experimental p-p cross section data strengthen the belief that the 80 m_π^2 particle is the predicted spin-2 particle. (D.C.W.)

24274 (UCRL-10585) A STUDY OF THE π^+ IN THE REACTION $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ AT 365 AND 432 Mev

(thesis). Julius Solomon (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 17, 1963. Contract W-7405-eng-48. 101p.

The differential distributions in energy and angle of the π^+ in the reaction $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ have been measured with a scintillation counter telescope used for π^+ detection and a magnetic spectrometer for π^+ energy determination at π^- incident energies of 365 and 432 Mev. At each of the laboratory-system angles 20, 50, 80, and 110° π^+ were detected in scintillation counters placed after the spectrometer. This system covered a major portion of the kinematically allowed π^+ energy spectrum. The values of T and $\Delta T \Delta \Omega$ for each counter after the spectrometer were determined by suspended-wire measurements. Loss in π^+ detection efficiency due to the decay of the π was calculated. The e^+ contamination in the π^+ telescope was calculated and found to agree with a measurement made at 20°. The total cross sections at 365 Mev, 2.39 ± 0.20 mb, and at 432 Mev, 3.98 ± 0.20 mb, are in agreement with other recent measurements. The angular distributions in the center-of-mass system (c.m.) are $d\sigma/d\Omega^*)_{365\ Mev} = [(190 \pm 16) + (10 \pm 27) \cos\theta^*]$ μb/sr and $d\sigma/d\Omega^*)_{432\ Mev} = [(317 \pm 16) + (35 \pm 26) \cos\theta^*]$ μb/sr. At the higher energy the forward peaking of the π^+ is less pronounced than in a previous measurement of that characteristic. Both total cross section and angular distribution can be explained to present accuracy with two models: a π-π interaction model and an isobaric model. The π^+ c.m. energy distributions were observed to peak at lower energies than predicted by a phase-space distribution, thereby suggesting the presence of isobar formation in the final state. An attempt was made to fit the energy-spectrum data to an isobaric model using as many as three parameters. At 375 Mev moderately good fits are obtained, whereas at 432 Mev no reasonable fit to the measured energy spectrum could be found. 38 references. (auth)

24275 (UCRL-10629) POLARIZATION OF RECOIL PROTONS IN PION-PROTON ELASTIC SCATTERING AT 523, 572, AND 689 Mev (thesis). Richard D. Eandi (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 18, 1963. Contract W-7405-eng-48. 80p.

Angular distributions of recoil-proton polarization for elastic scattering of positive and negative π mesons on protons were measured at 523, 572, and 689 Mev incident-pion kinetic energy. The pion source was an internal target of the Berkeley Bevatron. Polarization measurements were made by observing the azimuthal asymmetry of sample angular distributions of recoil protons that scatter in large carbon-plate spark chambers. The spark chambers proved to be very suitable polarization analyzer-detectors. The spark chambers were triggered by an array of scintillation and Čerenkov counters that identified the particles entering the chambers as recoil protons from elastic pion-proton scattering. Two plausible nonunique sets of phase shifts were obtained by employing: restrictive assumptions related to the higher resonances, available pion-proton total and differential cross sections measured at nearby energies, and the measurements of this experiment. One set is characterized by a $J = 3/2$, $T = 1/2$, D-wave resonance; the other set is characterized by a $J = 3/2$, $T = 1/2$, P-wave resonance at 600-Mev incident-pion energy. 38 references. (auth)

24276 (UCRL-10677) BASIC THEORY AND APPLICATION OF REGGE POLES. C. Edward Jones and John A. Poirer (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 8, 1963. Contract W-7405-eng-48. 35p.

A development of the basic theory of Regge poles is given. The goal is to give a self-contained discussion that can be easily read without prior background knowledge of the subject. Emphasis is on physical ideas and experimental consequences rather than on rigor. The attempt is made to state explicitly the underlying assumptions behind the Regge pole hypothesis. 28 references. (auth)

24277 (UCRL-10703) STUDY OF $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ AT 1.25 AND 1.75 Bev/c FOR LOW-NUCLEON-MOMENTUM-TRANSFER COLLISIONS: EVIDENCE FOR PION-PION INTERACTIONS (thesis). William Brulé Johnson (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 27, 1963. Contract W-7405-eng-48p. 97p.

The interaction π^--p $\rightarrow \pi^-$-π^+-n at incident pion momenta of 1.25 and 1.75 Bev/c was studied. Two arrays of plastic scintillation counters were used to detect the final-state particles: the first array—15 cm thick, and 160 cm from the liquid-hydrogen target where the interaction occurred—detected both pions and neutrons in the forward π steradians; a second array of thin scintillators, placed near the hydrogen target, was used to detect pions in the remaining angular region. The energy of the neutron was determined by measuring its flight time from the liquid hydrogen target to the first array. Only neutrons from 5 to 65 Mev were detected, thus limiting the study to those collisions in which the four-momentum transfer squared from the proton to the neutron was less than 6.5 μ^2 (where μ is the mass of the pion). Study of the data as a function of the "mass" of the two-pion final-state system corroborates the presence of a pion-pion resonance at a mass value of 750 Mev. The width of the resonance is somewhat greater than that found in experiments dealing with other charge states. An attempt was made to extract pion-pion total cross sections from the data by the Chew-Low extrapolation method. The results obtained are physically untenable and indicate failure of the extrapolation method when applied to these data. Considerable evidence is found for final-state interaction between the neutron and one of the pions. The data are subjected to the Treiman-Yang test to discover any deviations from the one-pion-exchange model; considerable deviation is found for large momentum-transfer collisions. It is felt that the large resonance width and the failure of the Chew-Low extrapolation method are results of final-state interactions not accounted for in the one-pion-exchange model. 33 references. (auth)

24278 (UCRL-Trans-926(L)) ON THE SYSTEMATOLOGY OF X-RAY REFLECTION IN A SPACE LATTICE. W. Kossel. Translated by W. B. Distler (Univ. of California Lawrence Radiation Lab., Livermore) from Ann. Physik, (5), 25: 512-26(1936). 24p.

A basic procedure, already described at an earlier date, bearing upon the construction and graphic presentation of the overall possible reflections in a given crystal lattice and for a given x-ray wave length, is discussed in detail. The directions which point to a reflection and which emanate from it are drawn onto a pictorial sphere. Simple relationships exist with the reciprocal lattice and with the Ewald construction of reflective direction lines. An example is cited showing how the system of reflections develops with recessive wavelength in a face-centered cubic lattice. (auth)

24279 ON THE VARIATIONAL METHOD OF THE NONRELATIVISTIC SCATTERING. II. THE INTEGRAL FORM. F. B. Malik (Palmer Physical Lab., Princeton, N. J.; Fordham Univ., New York; and Pakistan Atomic Energy Commission, Karachi). Ann. Phys. (N. Y.), 21: 1-7(Jan. 1963).

The variational method for the scattering problem in its integral form is examined from the point of view of the

necessary criterion of the calculus of variation. This leads to the fact that Schwinger variational method requires a slight change. The necessary modification is suggested. An alternative form of the functional that corresponds exactly to the integral form of the variational method in its differential form is also proposed. (auth)

24280 STABILITY OF THE THERMAL HARTREE-FOCK APPROXIMATION. N. David Mermin (Univ. of Birmingham, Eng.). Ann. Phys. (N. Y.), 21: 99-121(Jan. 1963).

The thermal Hartree-Fock approximation of Green's function theory is shown to be equivalent, in its thermodynamic consequences, to the use of that density matrix that makes the free energy stationary over a simply restricted class of trial density matrices. The variational formulation provides a stability condition requiring one to reject those solutions of the thermal Hartree-Fock equations that do not correspond to local minima of the free energy. If only stable Hartree-Fock propagators are used, then the spectrum of density oscillations as calculated in the thermal random phase approximation can be shown to have only real frequencies. Reasons for the thermal RPA becoming unstable may therefore be found from studying the significance of unstable Hartree-Fock solutions. It is shown that isothermals with positive slope can occur in the Hartree-Fock equation of state only if an unstable solution has been used. This suggests that one type of instability is associated with a first order phase transition. This is confirmed when the approximation is applied to a lattice gas with attractive interactions. The equation of state is of the van der Waals type if the stability condition is ignored. If only solutions that give global minima to the free energy are used, the corrected isothermals are those that result from applying the Maxwell equal area construction to the naive ones. Unstable solutions correspond to the parts of the van der Waals isothermals with positive slope. The physically metastable parts correspond to solutions that are local but not global minima. A lattice gas with repulsive interactions illustrates another type of instability, characterizing a second order phase transition. In this case the naive solution becomes unstable even though no pathological behavior appears in its equation of state, and solutions corresponding to a spatially nonuniform density of particles are required to restore stability. (auth)

24281 REGGE POLES AS CONSEQUENCES OF ANALYTICITY AND UNITARITY. S. Mandelstam (Univ. of Birmingham, Eng.). Ann. Phys. (N. Y.), 21: 302-43(Feb. 1963).

It is shown that a scattering amplitude that satisfies a double-dispersion relation and elastic unitarity is meromorphic in the complex l-plane for Re l greater than some negative quantity, and that its asymptotic behavior in the momentum transfer is therefore given by the Regge formula. In the proof it is necessary to assume that the scattering amplitude is bounded by ts^{-1} (for pion-pion kinematics) as both s and t become infinite, but it is argued that, if this limit is not satisfied, the dispersion integrals in s will be dominated by the high-energy region and, in all probability, those in t will require an infinite number of subtractions. In contrast to the Schrödinger or Bethe-Salpeter cases, the positions of the Regge pole at high energy will depend on the strength of the coupling. This high-energy Regge pole appears to come into the right half-plane for repulsive potentials and to correspond to a ghost rather than bound state. If and only if it were to reach the value l = 1, the boundedness condition would no longer be satisfied. (auth)

24282 ON RESONANCES IN A SYSTEM OF COUPLED TWO-PARTICLE CHANNELS. Saul Barshay (Brandeis Univ., Waltham, Mass.). Ann. Phys. (N. Y.), 21: 383-400 (Feb. 1963).

A simple model of a system of coupled two-particle channels is solved exactly. It is shown that a narrow resonance can occur at a relatively low energy, especially if all of the two-particle channels have angular momentum greater than zero, or if one nearby closed S-wave channel is present. The resonance manifests itself at a given energy in all of the T-matrix elements, although it may be considerably weaker in some elements than in others. Within the framework of the model, the essential dynamical origin of the resonance is the coupling between the channels, plus, an interaction peculiar to one of the channels. If the Born matrix elements coupling different channels have the property that they grow rapidly with increasing energy, this can result in a resonance behavior for the transition matrix at a lower energy where these Born elements are still small. An attempt is made to see whether this type of resonance might describe the isotopic spin zero, negative strangeness, meson-baryon resonances observed at 1405 Mev and at 1525 Mev. Both of these resonances satisfy a requirement of the model that the center-of-mass momenta in all of the coupled two-particle channels be relatively low. Within the framework of this model, the 1525 Mev resonance might be viewed as a virtual-bound state of the Λ hyperon and an isoscalar, scalar meson (or $\pi-\pi$ resonant state) with total energy of about 400 Mev. The 1405-Mev resonance might similarly be viewed as a virtual-bound state of the Λ hyperon and an isoscalar, scalar system with total energy about twice the pion mass. (auth)

24283 ON THE LEVINSON THEOREM IN THE MULTICHANNEL CASE. G. C. Ghirardi (Università, Parma, Italy and Istituto Nazionale di Fisica Nucleare, Parma, Italy), M. Pauri, and A. Rimini. Ann. Phys. (N. Y.), 21: 401-7 (Feb. 1963).

With the aid of simple multichannel models, the possibility is investigated of obtaining a connection between the number of bound states of the Hamiltonian operator and only a part of the scattering phase shifts at zero and infinite energy. (auth)

24284 THE WEAK AND THE STRONG COUPLINGS AND GENERAL COVARIANCE. R. Finkelstein and W. Ramsay (Univ. of California, Los Angeles). Ann. Phys. (N. Y.), 21: 408-33(Feb. 1963).

General covariance implies that the physical continuum is characterized by its connection as well as by its local structure; and therefore by the symmetries of the connection as well as of the local Lorentz and gauge groups. The connection of the local Lorentz group is as usual associated with the gravitational field; the corresponding connection of the gauge group is associated with the universal weak and electromagnetic couplings. The strong couplings have the complete symmetry of the local gauge group. The weak couplings have the lesser symmetry of the connection, which in turn corresponds to a subgroup of the local gauge group. There are four weak, charged vector bosons, associated in pairs with the right and left-handed connections of the gauge group; the only neutral vector is the photon. (auth)

24285 S-WAVE INTERACTION IN A THREE-PION SYSTEM AND THE DECAY OF $K_{\pi 3}$. A. N. Mitra and Shubha Ray (Univ. of Delhi). Ann. Phys. (N. Y.), 21: 439-52(Mar. 1963).

A model of s-wave (T = 0, 2) $\pi-\pi$ interaction is proposed from certain formal analogies with field theory on lines similar to a recent paper. The model leads in an exact

fashion to a relativistic effective range formula of the two phase shifts δ_0^0 and δ_0^2, from which a simple relation is obtained between the s-wave scattering lengths and the strength parameters of the corresponding interactions. The model is then used to solve a three-body Schrödinger equation in momentum space for the isovector 3π wave function in a purely outgoing state so as to make the results applicable to $K_{\pi 3}$ decay. The possible symmetries of the 3π system (with two pions identical) are fully taken into account. This wave function is then employed for evaluation of the energy distribution of the unlike pion in τ decay, on the usual assumption of zero range for the weak interaction. The results are qualitatively similar to those known from earlier dispersion theoretic treatments. However attractive, π-π interactions seem to have little effect on the spectrum, suggesting that the structure of the weak interaction itself plays the dominant role. (auth)

24286 RADIATIVE DECAY OF INTERMEDIATE BOSON. Richard Friedberg (Columbia Univ., New York). Ann. Phys. (N. Y.), 22: 68-93(Apr. 1963).

The W particle is a hypothetical charged vector meson playing a role in weak interactions. The radiative decay, $W^- \rightarrow l^- + \bar{\nu} + \gamma$, of this particle is treated here in second order perturbation theory. The total decay rate contains an infrared divergence which is cut off roughly at a photon energy of 10 Mev. Differential and total rates are calculated and the total rate is compared with that of the nonradiative decay, $W^- \rightarrow l^- + \bar{\nu}$. It is found that the ratio of radiative to nonradiative decay is quite insensitive to the magnetic moment parameter of the W meson, but increases substantially with increasing W mass. For a W mass of 1000 Mev, the branching ratio is about 10^{-1} if l^- is e^- or 10^{-2} if l^- is μ^-. It is suggested that the magnetic moment parameter may affect some aspects of the angular distribution. It is noted that if the gyromagnetic ratio of the W is exactly 2, then the $\bar{\nu}$ and γ cannot come off in the same direction. (auth)

24287 BOUND STATES EMBEDDED IN THE CONTINUUM AND THE FORMAL THEORY OF SCATTERING. Luciano Fonda (Università, Parma, Italy and Istituto Nazionale di Fisica Nucleare, Parma, Italy). Ann. Phys. (N. Y.), 22: 123-32(Apr. 1963).

The formal theory of scattering is developed when bound states embedded in the continuum are present. It is shown that it is still possible to define the scattering matrix due to the vanishing of the matrix element connecting the state vector describing the generic bound state embedded in the continuum with the unperturbed state pertaining to the same energy. The scattering matrix does not exhibit a polar singularity, or could even be not singular, at the energies of these bound states. (auth)

24288 ON NUCLEON MAGNETIC MOMENTS. S. K. Kundu (Australian National Univ., Canberra). Australian J. Phys., 16: 108-14(Mar. 1963).

The magnetic moments of the proton and neutron are computed for the pseudoscalar-pseudovector symmetric meson field considering the magnetic moments as the time average of the proton and the meson magnetic moments. Using the perturbation theory, the meson contribution is calculated from the self-energy of a nucleon in presence of a weak homogeneous magnetic field where the term due to meson magnetic energy was introduced from the expression for the force exerted on the emitted meson by the magnetic field. The self-energy is made finite with the idea of a fundamental length and the cut-off so obtained fits exactly with that suggested by Chew in the extended-source theory. It is also found that mesons need to be present only about 25% of the time to explain the observed magnitudes of the anomalous nucleon magnetic moments. (auth)

24289 THE REACTION $D(p,\gamma)He^3$ BELOW 50 kev. G. M. Griffiths, M. Lal, and C. D. Scarfe (Univ. of British Columbia, Vancouver). Can. J. Phys., 41: 724-36(May 1963).

The yield and angular distribution of the γ rays from the reaction $D(p,\gamma)He^3$ were measured with thick heavy-ice targets in the energy range from 24 to 48 kev. Assuming a simplified energy dependence the results were analyzed to give cross sections for p-wave and s-wave capture. At 25 kev in the laboratory system, the cross sections are $\sigma_p = (2.9 \pm 0.3) \times 10^{-32}$ cm^2 and $\sigma_s = (1.3 \pm 0.3) \times 10^{-32}$ cm^2. The astrophysical S-factors in the center-of-mass system below 40 kev were found to be $S_p = [(0.127 \pm 0.013) + 0.0079\ E]$ ev barns for E in center-of-mass kilovolts and $S_s = 0.12 \pm 0.03$ ev barns independent of energy giving a total S-factor for low energies $S = S_s + S_p = (0.25 \pm 0.04) + 0.0079\ E$ ev barns with E in center-of-mass kilovolts. (auth)

24290 ON HYPERON PRODUCTION IN NUCLEON-NUCLEON INTERACTIONS. V. A. Lul'ka (Kurchatov Inst. of Nuclear Energy, Academy of Sciences, USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 108-11(1963). (In Russian)

Production of Λ and K in $p + p \rightarrow \Lambda + p + K^+$ at energies below the Σ production threshold was investigated. Angular and energy distributions in $p + p \rightarrow \Lambda + p + K^+$ were calculated considering finite state interactions. It is shown that in the $\Lambda - p$ system interaction effects influences the shape of the spectra. The interaction effect was found experimentally. (tr-auth)

24291 AXIOMATIC PERTURBATION THEORY. II. PARTIAL SUM FORMALISM. H. M. Fried (New York Univ., New York). J. Math. Phys. (N. Y.), 4: 451-64(Apr. 1963).

A generalization of axiomatic perturbation theory is described in which propagator structure is introduced into the basic formalism, effectively resulting in a systematic rearrangement of the perturbation expressions representing a given process. The exact retarded functional of a simple boson field theory is decomposed into a sum of approximate functionals, and all the n-point functions of the first few approximate functionals are determined from modified unitarity equations and a knowledge of the corresponding perturbation functions. The resulting amplitudes differ from the perturbation amplitudes by the replacement of the perturbative spectral functions with related spectral functions depending upon the latter and on the propagator structure. Sets of integral equations for the higher functionals are proposed and solved. (auth)

24292 GROUP PROPERTIES OF FREE-FIELD EQUATIONS. V. Amar (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan), M. Lucchini, and P. G. Sona. J. Math Phys. (N. Y.), 4: 465-8(Apr. 1963).

It is shown that a set of n free-field equations and suitable commutation relations relevant to spin 0 to $\frac{1}{2}$ fields, is invariant with respect to a continuous group of transformations isomorphic to the n-dimensional real orthogonal group. It is found that such a set can always be derived from a given particle multiplet. The continuous group found in this way, includes as sub-groups the isotopic rotations and the gauge groups related to baryon number and strangeness. Hence this method enables us to reobtain the results reached by others in some particular cases, and to extend them to all particle multiplets. (auth)

24293 N-BODY BOSE SYSTEM WITH A FINITE NUMBER OF STATES. I. IRREDUCIBLE REPRESENTATIONS. Joseph B. Aviles, Jr. (Naval Research Lab., Washington, D. C.). J. Math Phys. (N. Y.), 4: 473-83(Apr. 1963).

For the purpose of investigating the n-body bose system with a finite number of states, the matrix $X_{ij} = A_i^{\dagger}A_j$, i, $j \leq K$ is analyzed. (A and $A^{\dagger}$ are the usual annihilation and creation operators of the second quantization formalism). The Hamiltonian for a fixed number of particles may be expressed in terms of the irreducible representations of the X_{ij}. A set of fundamental equations is defined for the irreducible representations $X_{ij}(N,K)$, i, $j \leq K$ and is solved for arbitrary N and K. The analysis of the structure of the $X_{ij}(N,K)$ yields a simple, systematic method for listing all possible ways in which $n_1 + \ldots n_i + \ldots + n_K = N$ may be satisfied for n_i positive integral or zero. This leads to a particularly simple method for constructing the $X_{ij}(N,K)$, i, $j \leq K$. (auth)

24294 DERIVATION OF THE GELL-MANN-OKUBO MASS FORMULA. H. Goldberg and Y. Lehrer-Ilamed (Israel Atomic Energy Commission, Rehovoth). J. Math. Phys. (N. Y.), 4: 501-2(Apr. 1963).

A short proof is given for a mathematical identity which is used to derive the Gell-Mann–Okubo baryon mass formula. (auth)

24295 HIGH-ENERGY BEHAVIOR IN PERTURBATION THEORY. J. C. Polkinghorne (Cambridge Univ., Eng.). J. Math Phys. (N. Y.), 4: 503-6(Apr. 1963).

The dominant-high energy behavior of a wide class of Feynman diagrams is investigated. When the leading contributions are summed, they are shown to give a behavior consistent with the Regge-pole hypothesis. Series expansions for the trajectory and residue of the dominant Regge pole are obtained in this approximation. (auth)

24296 SOME ANALYTIC PROPERTIES OF GREEN FUNCTIONS AND SELF-ENERGY PARTS FOR A SYSTEM OF INTERACTING BOSONS. W. E. Parry and R. E. Turner (Oxford Univ.). J. Math. Phys. (N. Y.), 4: 530-3(Apr. 1963).

Some analytic properties of the single-particle Green functions and proper self-energy parts for a system of interacting bosons at nonzero temperatures are derived. In particular, it is shown how to obtain the analytical continuations of simple functions of the proper self-energy parts, which can be obtained from perturbation theory at an infinite set of points along the imaginary energy axis, to the whole of the complex energy plane. This is useful in determining the poles of the Green functions. (auth)

24297 GENERALIZED MASTER EQUATION AND t-MATRIX EXPANSION. Robert J. Swenson (Lehigh Univ., Bethlehem, Penna.). J. Math. Phys. (N. Y.), 4: 544-51 (Apr. 1963).

Mathematical aspects of the generalized master equation are discussed. The resolvent operator is expanded in terms of a two-body scattering matrix and this result is used to express the quantities in the generalized master equation in terms of expansions in the scattering matrix. The expansions are utilized in studying the density dependence of these quantities. (auth)

24298 INELASTIC SCATTERING OF ELECTRONS WITH A DEFINITE MOMENTUM TRANSFER IN A CRYSTAL. Akira Fukuhara (Hitachi Central Research Lab., Tokyo). J. Phys. Soc. Japan, 18: 496-503(Apr. 1963).

A formulation is presented that describes the inelastic scattering of electrons by a crystal with a definite momentum transfer and a small energy loss. The Bragg reflection of both the elastic and inelastic waves is treated in the frame of the dynamical theory. This formulation is especially suitable for the discussion of the inelastic scattering in the plasmon-excitation process, where the Bragg condition for the inelastic wave is not so much altered from that for the elastic one because of the small change of momentum in this process. A numerical example for the intensity of the inelastic waves is demonstrated to describe the equi-thickness interference fringes formed by plasma loss electrons. (auth)

24299 ELEMENTARY PARTICLE RESONANCES. D. J. Holthuizen (Zeeman Laboratorium, Amsterdam). Ned. Tijdschr. Natuurk., 28: 16-26(Jan. 1962). (In Dutch)

The resonances of elementary particles are described separately with a discussion of the nucleon, pion, kaon, and hyperon isobars. (J.S.R.)

24300 ALLOWED BETA DECAY. J. van Klinken, H. P. C. Rood, and H. de Waard (Rijksuniversiteit, Groningen, Netherlands). Ned. Tijdschr. Natuurk., 28: 33-64(Feb.-Mar. 1962). (In Dutch)

A survey of classical and parity experiments on allowed beta decay, introduced with a classification of the types of experiments, is given. The most important experiments, together with results and conclusions, are tabulated. 51 references. (J.S.R.)

24301 REACTIONS CAUSED BY HIGH-ENERGY NEUTRINOS AND THE EXISTENCE OF TWO TYPES OF NEUTRINOS. S. R. de Groot (Instituut Lorentz, Leiden). Ned. Tijdschr. Natuurk., 28: 184-6(June 1962). (In Dutch)

The experimental data indicating the existence of two types of neutrinos are summarized. The two neutrinos are the "muleptons" μ^- and ν_μ (with μ^+ and $\bar{\nu}_\mu$ as antiparticles) and the "e leptons" e^- and ν_e (with e^+ and $\bar{\nu}_e$ as antiparticles). The theoretical basis of the study made with high-energy neutrinos to indicate the existence of two types of neutrinos is reported. (J.S.R.)

24302 EXPERIMENTAL CONFIRMATION OF THE "CONSERVED VECTOR CURRENT" THEORY OF WEAK INTERACTIONS. S. R. de Groot (Instituut-Lorentz, Leiden). Ned. Tijdschr. Natuurk., 28: 253-66(Aug. 1962). (In Dutch)

The traditional theory of weak interactions is briefly reported. The most important solutions of the conserved vector current theory are given. In conclusion, a number of experiments with which the conserved vector current theory can be verified are described. The principal methods are based on beta activity of the π meson, equality of the coupling constants g_V in beta and muon decay, weak magnetism, and beta-alpha and beta-gamma correlations. (J.S.R.)

24303 A FEW RECENT DEVELOPMENTS IN THE AREA OF WEAK INTERACTIONS. H. A. Tolhoek (Rijksuniversiteit, Groningen, Netherlands). Ned. Tijdschr. Natuurk., 28: 373-91(Nov. 1962). (In Dutch)

A survey is given of recent developments on weak interactions with emphasis on weak interactions involving strange particles (hyperons and K mesons). The types of weak interactions considered are classified into four groups: processes in which only leptons appear; processes in which, in addition to leptons, baryons and/or mesons appear and in which the strangeness is conserved; processes in which, in addition to leptons, baryons or mesons appear and in which the strangeness is not conserved; and processes in which no leptons appear and in which the strangeness is not conserved. The representations of these four cases are given. Five rules controlling these

weak interactions are cited, and the consequences of these rules are discussed in detail. In conclusion, the hypothesis of the intermediate vector boson and γ decay of the muon are considered. (J.S.R.)

24304 THE INFLUENCE OF MULTIPLE SCATTERING ON THE MEASUREMENT OF THE CIRCULAR POLARIZATION OF γ-RAYS. H. Huber, S. Galster, and H. Schopper (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrums, Karlsruhe, Ger.). Nucl. Instr. Methods, 21: 338-44(Feb. 1963). (In English)

The circular polarization of γ rays is usually measured by Compton forward scattering from comparatively thick (about 1 cm) magnetized iron cylinders. Therefore, multiple scattering was determined by measuring the counting rate as a function of the iron thickness and was indeed found large (up to 35%). Nevertheless, it was shown that multiple scattering decreases the polarization efficiency by only a few percent for the photon energy range between 600 and 1220 kev. (auth)

24305 A STUDY OF VARIATIONAL WAVE FUNCTIONS FOR THE ALPHA PARTICLE. E. W. Schmid (Oak Ridge National Lab., Tenn. and Florida State Univ., Tallahassee), Y. C. Tang, and R. C. Herndon. Nucl. Phys., 42: 247-53 (Apr. 1963). (In English)

The upper and lower bound for the energy of the alpha particle were calculated with several different trial wave functions. The best result for both bounds is obtained with a function that is a product of solutions of the two-nucleon Schrödinger equation up to a certain inter-nucleon separation and goes over into a variational function for larger distances. With this trial function the results for the energy and the rms radius agree quite well with that obtained by Mang and Wild in an independent-pair model calculation. (auth)

24306 A MEASUREMENT OF THE WOLFENSTEIN R PARAMETER IN p-p SCATTERING AT 141 Mev. L. Bird, D. N. Edwards, B. Rose, A. E. Taylor, and E. Wood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 42: 280-93(Apr. 1963). (In English)

Measurements were made of the rotation parameter at cm angles of 24.0, 32.7, 45.7, 54.4, 67.2, 76.1, 84.0, and 90.0 degrees. The values obtained were -0.224 ± 0.051, -0.203 ± 0.051, -0.178 ± 0.031, -0.212 ± 0.042, -0.213 ± 0.040, -0.147 ± 0.063, -0.142 ± 0.136, and $+0.110 \pm 0.131$, respectively. This is the first experiment in which asymmetries were measured using a solenoid to precess proton spins in a polarized proton beam, and the method is discussed in detail. (auth)

24307 A MEASUREMENT OF THE WOLFENSTEIN A PARAMETER IN p-p SCATTERING AT 143 Mev. O. N. Jarvis, B. Rose, J. P. Scanlon, and E. Wood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 42: 294-305(Apr. 1963). (In English)

Measurements have been made of the asymmetry parameter at cm angles of 32.2, 43.2, 54.6, 65.0, 74.8, and 84.8 degrees. The values obtained were -0.405 ± 0.032, -0.377 ± 0.037, -0.342 ± 0.050, -0.355 ± 0.075, -0.198 ± 0.079, and $+0.022 \pm 0.154$, respectively. (auth)

24308 NUCLEON-NUCLEON PHASE SHIFTS AT 142 Mev. J. K. Perring (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 42: 306-12 (Apr. 1963). (In English)

Proton-proton scattering data are analyzed in terms of phase shifts. A unique fit is found. An analysis is also made of neutron-proton data at the same energy, using the $T = 1$ phases already found to determine the $T = 0$ phases. (auth)

24309 SYMMETRY PROPERTY OF RELATIVE COORDINATES (OR MOMENTA) IN A SYSTEM OF n IDENTICAL PARTICLES. M. Grynberg and Z. Koba (Inst. of Nuclear Research, Warsaw). Nucl. Phys., 42: 313-20(Apr. 1963). (In English)

It is shown that any components of $(n-1)$ relative coordinate (or momentum) vectors of n identical particles make up bases of $(n-1)$-dimensional irreducible representations of the permutation group S_n corresponding to the Young diagram. A simple application of this property is presented. (auth)

24310 BOSON-LIKE BEHAVIOUR OF PAIRS OF FERMIONS. [PART] I. Amnon Katz (Stanford Univ., Calif.). Nucl. Phys., 42: 394-415(Apr. 1963). (In English)

A class of diagrams corresponding to the binary collision approximation is chosen out of the perturbation expansion of the thermodynamic potential in diagrams drawn on a cylinder. A subclass of these diagrams corresponding to the formation of non-overlapping pairs is first summed yielding the expected result that these pairs behave as free bosons. Exchange effects between pairs are then included as insertions in the former diagrams. This yields an approximation valid up to much higher densities. The pairs now behave as interacting bosons. They still condense at low temperature. The assembly of condensed pairs at zero temperature can maintain a chemical equilibrium with a Fermi sea of unpaired particles. In this way a system of arbitrary density can be approximated that exhibits a smeared Fermi surface and superfluid characteristics. In the translationally invariant case a simple pairing of the Bardeen-Cooper-Schrieffer type prevails. However this is a result rather than an assumption. All results are gauge invariant. (auth)

24311 BOSON-LIKE BEHAVIOUR OF PAIRS OF FERMIONS. [PART] II. Amnon Katz (Univ. of Washington, Seattle and Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., 42: 416-27(Apr. 1963). (In English)

The boson-like behavior of pairs of fermions is generalized here to arbitrary densities. This is achieved by generalizing the summation over ladders that spiral around the cylinder to arbitrary values of the chemical potential and by including somewhat less insertion in these ladders. The result is a description of a paired system with smeared occupation number distribution. There is no inherent limit on the density. (auth)

24312 BARYONIUM ANNIHILATION INTO MESON + VECTOR MESON. H. Goldberg and Y. Ne'eman (Israel Atomic Energy Commission, Rehovoth). Nucl. Phys., 42: 638-41(Apr. 1963). (In English)

Assuming that the decay of baryonium into meson + vector meson proceeds through an intermediate virtual vector meson, some selection rules and branching ratios of this decay are derived from the octet version of unitary symmetry. (auth)

24313 A SOLUBLE MODEL FOR COMBINED PAIRING AND MONOPOLE-MONOPOLE INTERACTIONS. Anatole B. Volkov (Israel Inst. of Tech., Haifa). Nucl. Phys., 43: 1-10(May 1963). (In English)

A 0^+ spectrum, for any combination of attractive pairing and monopole-monopole interaction, for 4, 6, and 8 particles in the symmetric two-shell model is obtained by a perturbation procedure in which the exactly soluble zero order hamiltonian includes most of the collective effects. The method can be extended to the 10 and 12 particle case without the need for machine computation. (auth)

24314 NUMERICAL CALCULATION OF COULOMB WAVE FUNCTIONS FOR REPULSIVE COULOMB FIELDS.

H. F. Lutz and M. D. Karvelis (Univ. of California, Livermore). Nucl. Phys., 43: 31-44(May 1963). (In English) (UCRL-7002)

A description of the numerical calculation of Coulomb functions used in scattering and reaction calculations is given. A table of Coulomb functions for selected values of Coulomb parameter η over the range of 1 to 25 is also presented. (auth)

24315 PION DECAY AND THE EXPERIMENTAL DETERMINATION OF THE RENORMALIZATION CONSTANTS. Yasusi Ataka (Kinki Univ., Osaka). Nucl. Phys., 43: 60-8 (May 1963). (In English)

The pion decay amplitude is calculated for pseudoscalar pion-nucleon coupling using field equations, and is expressed in terms of the bare pion mass μ_0. Then it is shown that Goldberger-Treiman's damping factor corresponds to μ_0^2/μ^2, where μ is the physical pion mass. Generalizations of such a derivation are discussed. (auth)

24316 SOME EXTENSIONS OF THE BORN APPROXIMATION FOR PHASE SHIFTS. R. F. Dashen (Sandia Lab., Albuquerque, N. Mex.). Nuovo Cimento (10), 28: 229-39 (Apr. 16, 1963). (TID-16793; SCDC-2858). (In English)

A new approximation for phase shifts is derived using a method radically different from the usual Green's function techniques. It is a cross between the Born and WKB approximations and provides a powerful tool for investigating the behavior of the Born formula. In particular, the latter is shown to be valid for weak, long range potentials regardless of the magnitude of the phase shift. Several numerical examples are included. (auth)

24317 ELASTIC ELECTRON-DEUTERON SCATTERING AT LOW MOMENTUM TRANSFERS. B. Grossetête, D. Treille, and P. Lehmann (École Normale Supérieure, Orsay, France and Université, Paris). Nuovo Cimento (10), 28: 240-9(Apr. 16, 1963). (In English)

The effective cross section for electron-deuteron elastic scattering was measured at 60, 90, and 130° for a momentum transfer equal to 1 fermi^{-1}. The results were analyzed with the aid of recent calculations of Glendenning and Kramer. Using the proton form factors, the neutron charge form factor and Pauli form factor were found to have the values 0.015 ± 0.009 and 0.67 ± 0.10. The ratio of the neutron and proton form factors was 0.75 ± 0.11. (tr-auth)

24318 POLARIZATION EFFECTS IN PROTON-PROTON HIGH-ENERGY SCATTERING. C. Itzykson and M. Jacob (Centre d'Etudes Nucléaires, Saclay, France). Nuovo Cimento (10), 28: 250-62(Apr. 16, 1963). (In English)

High-energy proton-proton scattering is studied in the approximation of the exchange of a few Regge trajectories. The complications due to spin are analyzed. Differential cross sections for polarized beam or target are derived. (auth)

24319 N/D CALCULATION OF THE POMERANCHUK- AND ρ-REGGE TRAJECTORIES. P. G. O. Freund (Univ. of Chicago). Nuovo Cimento (10), 28: 263-9(Apr. 16, 1963). (EFINS-62-63). (In English)

A relativistic N/D treatment of the $(\pi\pi)$ system, using as input the force due to ρ-exchange, is presented. The shape of the I = 0 and 1 Regge trajectories is shown to approximate within 30% the expected trajectories of the Pomeranchuk and ρ poles, respectively. The corresponding residuum functions turn out to be of the correct order of magnitude. A multichannel generalization of the calculation, aimed to improve the qualitative reliability of the model, is sketched. (auth)

24320 STUDY OF THE REACTION $\mu^- + {}^4\mathrm{He} \rightarrow {}^3\mathrm{H} + n + \nu$. A Bietti and P. Di Porto (Istituto Nazionale di Fisica Nucleare, Rome and Università, Rome). Nuovo Cimento (10), 28: 270-8(Apr. 16, 1963). (In English)

The capture rate and the neutron and triton spectra are calculated for the capture of muons by He^4. A possible final state interaction is taken into account, and this effect is shown to be quite small. (auth)

24321 PROTON MOMENTUM SPECTRUM IN π^--p COLLISIONS AT 6 Gev/c. M. Bloch (Ecole Polytechnique, Paris). Nuovo Cimento (10), 28: 279-83(Apr. 16, 1963). (In English)

Pion-proton collisions were studied at 6 Bev/c in a heavy liquid bubble chamber. The momentum distribution, in the laboratory system, of the recoiling protons, which are too energetic to be visually separated from positive pions, was obtained by a subtraction method based on pion identification. Delta-ray production provides that identification with negative tracks being used to estimate the detection efficiency. An overall picture of the proton behavior can thus be obtained that confirms the predominance of glancing collisions in high-energy interactions. (auth)

24322 PROTON-ANTIPROTON ANNIHILATION INTO ELECTRONS AND MUONS. K. J. Barnes (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 28: 284-91(Apr. 16, 1963). (In English)

A formula for the electromagnetic annihilation of a particle-antiparticle pair of spin $\frac{1}{2}$ into another such pair is given in terms of covariant variables. This formula, which allows for the possibility of structure of both pairs, is then applied to the particular case of proton-antiproton annihilation into electron and muon pairs. (auth)

24323 MAXIMUM AND MINIMUM PRINCIPLE IN POTENTIAL SCATTERING. F. Calogero (Princeton Univ., N. J.). Nuovo Cimento (10), 28: 320-33(Apr. 16, 1963). (In English)

Representations for the tangent of the scattering phase shift are obtained, in which it appears as the maximum of an explicitly known functional and the minimum of another explicitly known functional. Similar representations may be used to evaluate the energies of bound states. (auth)

24324 REGGE TRAJECTORIES FOR THE SQUARE-WELL POTENTIAL. C. G. Bollini and J. J. Giambiagi (Facultad de Ciencias Exactas, Buenos Aires). Nuovo Cimento (10), 28: 341-55(Apr. 16, 1963). (In English)

From the analytic expression of the S-matrix the behavior of the Regge trajectories for the square-well potential is discussed. First, the positions of the poles for zero energy are found. For attractive potential, they are all real and infinite in number; the value of l being bounded from above. When the energy is increased, the poles move to the right becoming complex and approaching infinity with the energy. For negative energy they move to the left along the real axis, but eventually become complex, approaching infinity through complex values when the energy goes to minus infinity. (auth)

24325 A NOTE ON THE MEASURABLE ELECTRIC CHARGE OF SPIN-$\frac{1}{2}$ BOSONS. R. Spitzer (Argonne National Lab., Ill.). Nuovo Cimento (10), 28: 364-7(Apr. 16, 1963). (TID-17154; UAC-6724). (In English)

A heuristic argument is given that the definition of the measurable electric charge of spin-$\frac{1}{2}$ bosons is not unique in the sense that it is for spin-$\frac{1}{2}$ fermions. This indicates that such particles, if they exist, would not be charged particles in the classical sense. (auth)

24326 π^+-π^0 MASS DIFFERENCE. V. Barger and E. Kazes (Pennsylvania State Univ., University Park). Nuovo Cimento (10), 28: 385-93(Apr. 16, 1963). (In English)

An expression for the electromagnetic self-energy to first order in the fine structure constant, including all non-electromagnetic interactions without approximation, is derived in terms of a Compton scattering amplitude. The generalized form factors of this amplitude are evaluated for the $\pi^+ - \pi^0$ mass difference by dispersion-theoretic techniques. Using general physical principles to determine the contribution of the contact terms to the mass difference, we obtain the result given by Riazuddin. (auth)

24327 K_1^0-K_2^0 MASS DIFFERENCE. [PART] II. V. Barger and E. Kazes (Pennsylvania State Univ., University Park). Nuovo Cimento (10), 28: 394-400(Apr. 16, 1963). (In English)

An expression for any mass difference, exact in all strong interactions and of second order in weak interactions, is obtained directly from perturbation theory. Earlier results for the $K_1^0 - K_2^0$ mass difference are derived from this approach. Possible generalization of this model of the $K_1^0 - K_2^0$ mass difference is discussed. (auth)

24328 ELASTIC ELECTRON-DEUTERON SCATTERING OF WEAK MOMENTS OF TRANSFER. B. Grossetête and P. Lehmann (Ecole Normale Superieure, Orsay, France). Nuovo Cimento (10), 28: 423-34(Apr. 16, 1963). (In French)

A charge form-factor for the deuteron is defined, by the method that Sachs has developed for the nucleon form factors. This charge form-factor is the Fourier transform of the deuteron rest charge. The relativistic expression of the electron-deuteron cross section can be written as the sum of three squares without interference terms, and has a form very similar to the Jankus' formula. The deuteron charge form-factor is calculated using deuteron wave-functions and a practical formula for the elastic electron-deuteron scattering is obtained. The electron-deuteron elastic cross-section was measured for $q^2 = 0.88$ fermi^{-2} (60°), $q^2 = 1.00$ fermi^{-2} (60, 90, 130°), and $q^2 = 1.35$ fermi^{-2} (60, 110°). Using the wave function given by Glendenning and Kramer and the e-p elastic cross-section measured in the same laboratory the neutron charge form-factor is deduced. It is found to be positive and in agreement with the neutron-electron measurements. (auth)

24329 PARTICLE MASSES. K. M. Guggenheimer (Univ. of Glasgow). Nuovo Cimento (10), 28: 441-3(Apr. 16, 1963). (In English)

A table of empirical values for the particle masses of meson (π)-compound fermions, free fermions, and bosons is presented. Seven out of nine empirical masses correspond to bosons consisting merely of the mesons π, ρ, or compounds of these two. (C.E.S.)

24330 ON THE $\bar{p}p \rightarrow \bar{B}B$ REACTION AT 3 Gev/c. H. Goldberg (Israel Atomic Energy Commission, Rehovoth), S. Nussinov, and G. Yekutieli. Nuovo Cimento (10), 28: 446-51(Apr. 16, 1963). (In English)

The differential cross sections for baryon-antibaryon production in proton-antiproton interactions at 3 Bev/c are presented. The angular distribution of these reactions suggests that they are of a peripheral nature. Regge-pole formalism is applied in order to calculate the cross sections. (C.E.S.)

24331 A REMARK ON THE NEUTRINO THEORY OF LIGHT. I. M. Barbour, A. Bietti, and B. F. Touschek (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 28: 452-4(Apr. 16, 1963). (In English)

It is shown that the electromagnetic field arising from the neutrino theory of light is a gauge field. The impossibility of obtaining circularly polarized light from this theory is also demonstrated. (C.E.S.)

24332 DETERMINATION OF SPIN OF SOME LIGHT HYPERFRAGMENTS ($_\Lambda H^3 - {}_\Lambda H^4 - {}_\Lambda Li^8$). G. Baumann, H. Braun, and P. Cüer (Centre de Recherches Nucleaires, Strasbourg). Phys. Letters, 4: 131-2(Mar. 15, 1963). (In French)

As the proportions of different modes of mesic decay of a light hyperfragment is a function of the spin of the hyperfragment, their spin can be determined from the determination of the ratio of these different modes. For $_\Lambda H^3$, the ratio R_3 was calculated and a value $R_3 = 0.41 \pm 0.08$ was obtained; $J = 1/2$. For $_\Lambda H^4$, $J = 0$ and $R_4 = 0.76 \pm 0.10$. A comparison of the experimental and theoretical results for $_\Lambda Li^8$ shows $J = 1^-$, which confirms the predictions of Dalitz. (J.S.R.)

24333 ON ANGULAR MOMENTUM ANALYTICITY IN HARD CORE POTENTIAL SCATTERING. O. Brander (Chalmers Univ. of Tech., Goteborg). Phys. Letters, 4: 218-19(Apr. 15, 1963). (In English)

Analyticity of the scattering amplitude in the angular momentum (l) is proved for potential scattering when Re(λ)L0 in which $l = \lambda - 1/2$. From the edge of the hard core to infinity, the S-matrix for potential scattering is meromorphic in the topological product of the finite λ and k planes, except for two branch points in the k plane. At infinity, the hard core causes essential singularities for the S-matrix in both the λ and k plane. (C.E.S.)

24334 HIGHER GROUPS AND LEPTONIC ISOSPIN. A. Galindo and A. Marales (CERN, Geneva). Phys. Letters, 4: 219-21(Apr. 15, 1963). (In English)

The possibility of extending the isospin concept of heavy particles is analysed. Isospin multiplets of baryons or mesons with the same charge are considered and the possible consequences of this formalism regarding leptonic decays are explored. This extension is only strictly justified in the limiting case in which all the baryons or mesons are members of a higher group multiplet. (C.E.S.)

24335 STUDY OF THE I = 2 $\Sigma\pi$ SYSTEM IN π^+ N INTERACTIONS. G. R. Kalbfleisch, G. Alexander, O. I. Dahl, D. H. Miller, A. Rittenberg, and G. A. Smith (Univ. of California, Berkeley). Phys. Letters, 4: 225-7(Apr. 15, 1963). (In English)

A study of the effective-mass distributions for systems recoiling against mesons (k^+) produced both in π^- + p and π^- + n interactions is reported. Although all the known energetically accessible resonances are produced the data show no systematic enhancement that can be identified as arising from an I = 2 Yπ resonant state. A more favorable situation exists for $\Sigma^-\pi^0$ and $\Sigma^0\pi^-$ systems recoiling against mesons(k^+). The effective-mass distributions for all two-body final states produced in association with mesons(k^+) are plotted. (C.E.S.)

24336 VECTOR MESONS AND THE UNIQUENESS OF NUCLEON-NUCLEON SCATTERING AMPLITUDES. Riazuddin (Panjab Univ., Lahore) and Michael J. Moravcsik. Phys. Letters, 4: 243-6(Apr. 15, 1963). (In English)

The structure and uniqueness of proton-proton scattering amplitudes in the elastic region are considered. It is concluded that the one-meson exchange model, taking into account the independent exchanges of one meson (π), (η), (ρ) and (ω) only, gives an excellent approximation to the ex-

perimentally observed nucleon-nucleon scattering. Requirements of unitarity were not imposed, and the dispersion relations depend only on causality and the empirical spectrum of masses, spins, parities, and coupling constants. (C.E.S.)

24337 SINGLE PARTICLE ENERGIES IN THE MANY-PARTICLE GREEN'S FUNCTION FORMALISM. J. E. Young (Los Alamos Scientific Lab., N. Mex.). Phys. Letters, 4: 255-6(Apr. 15, 1963). (LADC-5707)

An explicit solution of the Baym and Kadanoff equation for the density-density correlation function in the many-particle Green's function formalism is presented. A self-energy operator corresponding to this solution is also obtained. (C.E.S.)

24338 ELEMENTARY PARTICLES OF CONVENTIONAL FIELD THEORY AS REGGE POLES. [PART] II. M. Gell-Mann (Massachusetts Inst. of Tech., Cambridge), M. L. Goldberger, F. E. Low, and F. Zachariasen. Phys. Letters, 4: 265-7(May 1, 1963). (In English) (TID-18114)

An examination of amplitude behavior shows that the conjecture that in the perturbation expansion of certain renormalizable field theories, elementary particles that appear in lowest order as fixed singularities in the complex angular momentum plane turn into moving Regge poles as a result of radiative corrections holds for a spin $\frac{1}{2}$ nucleon coupled to a neutral vector meson, but not for a spin 0 nucleon coupled to a neutral vector meson. (D.C.W.)

24339 FORMULATION OF THE QUANTUM MECHANICAL MANY-BODY PROBLEM IN TERMS OF ONE- AND TWO-PARTICLE FUNCTIONS. L. Szasz (Massachusetts Inst. of Tech., Cambridge). Phys. Letters, 4: 267-9(May 1, 1963). (In English)

Equations that determine the best two-particle approximation for the exact solution of a Schrödinger equation with the hamiltonian for N fermions are presented and examined. (D.C.W.)

24340 DIFFRACTION SCATTERING IN THE MULTIPERIPHERAL MODEL. D. Amati, M. Cini, and A. Stanghellini (CERN, Geneva). Phys. Letters, 4: 270-1(May 1, 1963). (In English)

Evidence that only part, not all, of the elastic scattering amplitude for diffraction scattering in the multiperipheral model displays Regge pole behavior is noted. For high energy inelastic processes, only the part of the elastic amplitude due to intermediate inelastic states displays such behavior. A way to evaluate the complete diffraction scattering that is the shadow of the inelastic absorption given by the model is proposed. (D.C.W.)

24341 K* GENERATION BY ρ EXCHANGE. B. Diu, J. L. Gervais, and H. R. Rubinstein (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Letters, 4: 280-2(May 1, 1963). (In English)

In accord with the proposal that all strongly interacting particles should be thought of as being bound states or resonances of one another and held by forces generated by the crossed channels, a model is proposed for the K* resonance in which the ρ meson provides the main binding force. (D.C.W.)

24342 PHOTOGRAPHIC METHOD IN STUDIES OF MULTIPLE PROTON SCATTERING. A. A. Bednyakov, A. N. Boyarkina, I. A. Savenko, and A. F. Tulinov (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 6, 35-40 (Nov.-Dec. 1962). (In Russian)

A multiple low-energy proton scattering with proton recording by photoplate installed perpendicular to the beam axis is described. Microphotometric beam image studies were used to find the distribution of the blackening density along the radius which in turn is transformed into the angular distribution of protons by means of densitometric characteristics developed by two exposures. (R.V.J.)

24343 ON THE SOLUTIONS OF THE LOW EQUATION. R. W. Lardner (Columbia Univ., New York). Proc. Cambridge Phil. Soc., 59: 55-61(Jan. 1963).

An alternative procedure is developed for examining the solutions of the Low equation. The ambiguities of those solutions that have a finite number of zeros are shown to satisfy the conditions derived earlier by Castillejo, Dalitz and Dyson. The method presented here has the advantage that it makes no special use of the positiveness of the cut-off function, and so can be used when this function changes sign. It is shown that the arbitrariness of the solution increases with the number of these sign changes, but that a completely negative cut-off function still satisfies the CDD conditions. (auth)

24344 ON COULOMB WAVE FUNCTIONS. A. S. Meligy and E. M. El Gazzy (Univ. of Alexandria, Egypt). Proc. Cambridge Phil. Soc., 59: 89-94(Jan. 1963).

The irregular radial Coulomb wave function in repulsive fields is expressed, for any angular momentum value, in series of Bessel functions of arbitrary order. Previous expansions, obtained for angular momenta zero and one, can now be obtained as special cases. The expansion can be most conveniently used for high-energy particles. (auth)

24345 AN INEQUALITY IN FEYNMAN INTEGRANDS. D. B. Fairlie (Cavendish Lab., Cambridge, Eng.). Proc. Cambridge Phil. Soc., 59: 157-60(Jan. 1963).

A proof by means of graphical techniques is given of an inequality conjectured by Nakanishi concerning the Feynman integrand for any term in the perturbation expansion of the scattering amplitude. (auth)

24346 DISPERSION RELATIONS FOR A TWO-CHANNEL SCATTERING PROCESS: RESIDUES OF THE SCATTERING AMPLITUDES. J. Underhill (Univ. of Glasgow). Proc. Cambridge Phil. Soc., 59: 161-6(Jan. 1963).

Expressions for the residues of the scattering amplitudes at the bound-state energies corresponding to bound-state wave functions for a non-relativistic two-channel process were derived. (C.E.S.)

24347 DIVERGENCEFREE COMPOSITE MODEL OF ELEMENTARY PARTICLES. Yoneji Miyamoto (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 28: 967-70(Dec. 1962). (In English)

The mass levels of vector octet (ω,ρ,K^*) and pseudoscalar octet (π,K,π_0) are evaluated on the basis of the Fermi-Yang-Sakata model by the N/D method. It is assumed that χ,ω,ρ,π, etc., are gluons of baryons and antibaryons, and, since they are also bound state of baryons and antibaryons (Regge poles), the theory is divergence-free. The possibility that the masses and the coupling constants of bosons should be determined from the unsubtracted dispersion integral of baryon-antibaryon scattering in a self-consistent way analogously to Chew-Mandelstam-Zachariasen's theory on the p-wave pion-pion resonance, if all bosons are a pure compound state of baryons and antibaryons, is discussed. (auth)

24348 PERTURBATION THEORY FOR DEGENERATE PROBLEMS OF MANY-FERMION SYSTEMS. Tohru Morita (Shizuoka Univ., Japan). Progr. Theoret. Phys. (Kyoto), 29: 351-69(Mar. 1963). (In English)

The linked cluster expansion of the eigenvalues and eigen-

functions of a many-fermion system is extended to the case where the eigenvalues of the unperturbed system are degenerate. It is shown that the eigenvalues and eigenfunctions are to be obtained by solving a secular equation in the space of degenerate unperturbed wave functions; the matrix elements between these unperturbed functions take the form of linked clusters with energy denominators that are the differences of unperturbed energies. Some discussions are given on the relation of this theory to the formalism of Bloch and Horowitz, in which the energy denominators are the differences of an unperturbed energy and the true energy that is to be obtained as the solution to the secular equation. (auth)

24349 INVESTIGATION OF p-p and n-p SCATTERINGS AT 10 Mev BY DISPERSION RELATION. Shih-Hui Hsieh (Tokyo Univ.) and Setsuko Miyachi. Progr. Theoret. Phys. (Kyoto), 29: 422-38(Mar. 1963). (In English)

The dispersion relation as the function of the momentum transfer is used to calculate the nucleon-nucleon scattering amplitudes as the functions of the angle at fixed energy in nonrelativistic approximation. The one-pion and two-pion contributions including the (3, 3) resonance are derived, and some results of a previous paper are corrected. The dispersion relation is applied to 10 Mev p-p and n-p scatterings. It is shown that, the calculated results for the imaginary parts of the amplitudes are good except a few terms, the results for the real parts of the amplitudes β, γ, and ϵ are also good for both of p-p and n-p scatterings, but those of α and δ are bad for both. Also it is indicated that, the contribution of the (3, 3) resonance is large, and the discontinuity of the spectral function appearing in the fourth order diagram gives an anomalously large contribution to the first amplitude α of n-p scattering. (auth)

24350 S-WAVE $\bar{K}$-N REACTIONS AND VECTOR MESONS BY SEMI-PHENOMENOLOGICAL AMPLITUDES. Tomoya Akiba (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 29: 439-50(Mar. 1963). (In English)

Semi-phenomenological amplitudes that are obtained by applying the one-pole approximation of the left-hand cuts are used to describe the S-wave $\bar{K}$-N reactions. The principal purpose is to examine possible energy dependences of the constant parameters in the zero range theory. It is assumed that Y_1^* is an $S_{1/2}$ Dalitz-Tuan type bound state and that the I = 0 complex scattering length has a negative and large real part near the $\bar{K}$-N threshold. It is shown that the I = 0 scattering length shows an energy behavior consistent with some indications from the experiment above the Y_1^*-mass, though the behavior becomes wrong at lower energies. The amplitudes also give qualitative information about potentials in each channel. The suggested features of the I = 0 channel potentials are well understood by a vector meson exchange model. A rough estimation of coupling constants of vector mesons is given. (auth)

24351 ON THE EXISTENCE OF POLES IN THE UNPHYSICAL SHEET. Seiya Aramaki and Takeo Osawa (Nagoya Univ., Japan and Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 29: 451-60(Mar. 1963). (In English)

It is proved that in the unstable Lee model the unstable particle propagator must have poles in the second Riemann sheet. The same holds in the Chew-Low static pion theory if the contributions from the inelastic processes are neglected. The ($\frac{3}{2}$, $\frac{3}{2}$) resonance state is introduced as poles in the second sheet and it is shown that the introduction of these poles is not sufficient to make the theory consistent, though it removes a considerable amount of discrepancies between the theory with no pole and experiment. Two alternative interpretations of this result are presented and discussed. (auth)

24352 NOTE ON ROSEN'S THEORY OF NONLEPTONIC HYPERON DECAY. Kanji Fujii and Yokio Itô (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 29: 463-4 (Mar. 1963). (In English)

Equivalence is established between previously proposed symmetry transformations and the generalized space inversion in the theory of nonleptonic hyperon decay. Correspondence between the weak interaction hamiltonians of these two transformations is also established. (C.E.S.)

24353 ON THE YANG-TREIMAN ASYMMETRY AND THE NUCLEON ISOBAR. Naoki Tokuda, Tetsuro Sakuma, and Akira Kanazawa (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 29: 464-6(Mar. 1963). (In English)

Relativistic perturbation theory was used to calculate the contribution of nucleon isobar formation in a previously reported deviation from the one-pion-exchange mechanism on the π-π scattering angular distributions in the reaction $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ at very low momentum transfer. It was found that the contribution of the nucleon isobar could not account for the large asymmetry reported. (C.E.S.)

24354 π-N SCATTERING IN OCTET MODEL. Yasuo Hara and Yoneji Miyamoto (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 29: 466-8(Mar. 1963). (In English)

The magnitude of the Born terms of the seven octet boson-octet fermion scattering amplitudes are calculated. The possibility of making the ten dimensional representation (3, 0) of the Yamaguchi-Gell-Mann-Ne'eman model scattering amplitude largest by a suitable choice of two independent Yukawa coupling constants is examined. (C.E.S.)

24355 AN APPROACH TO THE UNIFIED THEORY OF ELEMENTARY PARTICLES. Yasuhisa Katayama (Kyoto Univ.), Jean Pierre Vigier, and Hideki Yukawa. Progr. Theoret. Phys. (Kyoto), 29: 468-70(Mar. 1963). (In English)

A model for elementary particles based on relativistic rotators is considered as a promising approach to a unified theory. (C.E.S.)

24356 A THEORY OF WEAK INTERACTION BASED ON A ROTATOR MODEL. Yasuhisa Katayama (Kyoto Univ.), Jean Pierre Vigier, and Hideki Yukawa. Progr. Theoret. Phys., 29: 470-2(Mar. 1963). (In English)

A theory of weak interactions of elementary particles based on a relativistic rotator model described by the space-time point and two associated rotating frames is presented. (C.E.S.)

24357 MASS RELATIONS FOR STRONGLY INTERACTING PARTICLES AND RESONANCES. [PART] I. Takehiko Takabayasi (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 29: 472-4(Mar. 1963). (In English)

A set of simple mass relations that are sufficient to fix the mass spectrum of all baryons and mesons is presented. The relations are empirical but seem to suggest their eventual theoretical foundations. (C.E.S.)

24358 MASS RELATIONS FOR STRONGLY INTERACTING PARTICLES AND RESONANCES. [PART] II. Takehiko Takabayasi (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 29: 474-5(Mar. 1963). (In English)

Simple mass relations for baryons and their resonance states are presented. (C.E.S.)

24359 ON THE SCATTERING OF X RAYS AT SMALL ANGLES. Jean-Pierre Jan (National Research Council,

Ottawa). Z. Angew. Math. Phys., 14: 1-11(1963). (In French)

The scattering of X rays at small angles due to submicroscopic cavities in galvanic deposits was studied. A series of formulas for a Maxwellian and Gaussian distribution of particle sizes is derived, and the slit height correction is considered. The theory is used to analyse experimental data on electrolytic copper deposits containing gelatin in spherical inclusions. Results agree well with direct observation in the electron microscope. In most cases, the type of distribution and the height correction were negligible. (C.E.S.)

24360 PION-PION INTERACTION AND $K_{2\pi}$ DECAY. P. Stichel, G. Roepstorff, and G. Kramer (Physikalische Staatsinstitut, Hamburg-Bahrenfeld, Ger.). Z. Physik, 173: 361-73(1963). (In English)

The enhancement of the $K^{+}_{2\pi}$-decay compared to the $K^{0}_{2\pi}$-decay is discussed on the basis of the $|\Delta I| = 1/2$-rule. The enhancement factor was calculated by dispersion methods which yield an expression depending only on the phase shift of the two-pion system in the J = 0, I = 0,2 state. This expression was studied in the framework of simple models for the two-pion interaction in order to obtain a survey of the possibilities for the cause of the anomalous large ratio $K^{+}_{2\pi}/K^{0}_{2\pi}$. Only characteristic cases were considered and, as far as possible, experimental results of the π-π interaction are taken into account. (auth)

24361 ON NUCLEAR FUSION IN MUON MOLECULES. U. Schroeder (Universität, Freiburg i. B.). Z. Physik, 173: 432-7(1963). (In German)

Using results of a preceding paper, the wavefunctions of nuclear vibrations in muon molecules were calculated by numerical integration, especially at small nuclear distances. These functions were then used to determine reaction rates of nuclear fusion. The effect of nuclear forces on the wavefunction at very small distances was estimated and taken account of. The numerical results reasonably agree with (pμd) experiments. (auth)

24362 ON THE CONNECTION BETWEEN THE DECAYS $\pi^{0} \rightarrow 2\gamma$ AND $\pi^{+} \rightarrow e^{+} + \nu + \gamma$. V. F. Mueller (Univ. of California, San Diego, La Jolla). Z. Physik, 173: 438-40 (1963). (In English)

A result discovered by Vaks and Ioffe was derived using reduction technique and G-invariance only. It has some consequences concerning the decays $\pi^{0} \rightarrow 2\gamma$ and $\pi^{+} \rightarrow e^{+} + \nu + \gamma$ and various coupling constants of the ρ and ω particle. (auth)

24363 THE VAVILOV-CHERENKOV EMISSION DURING ELECTRON BUNDLE FLIGHT ACROSS A DIELECTRIC TUBE. A. G. Bonch-Osmolovskii (Leningrad Electrochemical Inst.). Zh. Tekhn. Fiz., 33: 296-300(Mar. 1963). (In Russian)

The problem of Vavilov-Cherenkov emission in electron beam flight through a dielectric tube was resolved. A dispersion equation was obtained for determining the possible frequencies, and a universal formula was developed for radiation intensity in a medium without losses. (tr-auth)

24364 AN EXPERIMENT ON THE RADIATIVE CAPTURE IN FLIGHT OF PIONS IN HYDROGEN AND A MEASUREMENT OF THE π^{-}-π^{0} MASS DIFFERENCE. W. C. Middelkoop. Thesis, Amsterdam, Universiteit Amsterdam, 1962. 78p.

Interest in and problems connected with the measurement of the cross section for the radiative capture in flight ($\pi^{-} + p \rightarrow \gamma + n$) are discussed, and equipment used in the detection of photons and neutrons is examined. The time-of-flight arrangement used to measure the differential cross section for 72 Mev π^{-} as 70 ± 7 μb/sr is explained, and methods for measuring the π^{-}-π^{0} mass difference are reviewed. Another time-of-flight experiment yielded a value of (9.01 ± 0.08) electron masses for this difference. (D.C.W.)

Neutron Physics

24365 (AAEC/E-107) THEORY AND APPLICATION OF THE DOUBLE P_N METHOD IN SLAB GEOMETRY FOR ISOTROPIC NEUTRON SOURCES AND SCATTERING. J. J. Thompson (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Apr. 1963. 8p.

A simple matrix formalism is developed to facilitate the application of the double P_N method of spherical harmonics to multiple slab configurations, representative of some of the basic neutron transport problems in the theory of nuclear reactors. Special attention is given to the double P_2 and P_3 approximations, and the results of numerical computations are compared with known accurate results. The double P_3 Fortran programs and subroutines used for the calculations are included. (auth)

24366 (AAEC/TM-186) THE INCLUSION OF GREY SLABS IN THE FINITE DIFFERENCE NEUTRON DIFFUSION APPROXIMATION. J. J. Thompson (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1963. 12p.

An analysis of the behavior of the asymptotic flux on either side of a strongly absorbing grey slab in an otherwise uniform medium, with an arbitrary distribution of sources, leads to a method of accounting for the effect of the slab within the framework of the diffusion approximation. It is necessary to introduce a new parameter, the linear extrapolation distance at the surface of the slab in an anti-symmetrical neutron distribution. (auth)

24367 (BRL-1189) NEUTRON REFLECTION AND FLUX VERSUS DEPTH FOR CONCRETE. Frank J. Allen, Arnold Futterer, and William Wright (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Jan. 1963. 115p.

Detailed calculated results on neutron reflection and flux versus depth for concrete are given in the form of machine printouts. The angular and energy distributions of the reflected neutrons along with the energy-dependent and total flux at various depths are contained in tabular form on the printouts. Neutron number current, number flux and dose transmission as functions of thickness are also given in tabular form on the printouts. A table of summary information on reflection is presented. This contains number current, number flux, dose and energy reflection factors as functions of incident energy and angle. A few figures are presented to illustrate graphically the meaning of the various tabular results. (auth)

24368 (GA-3469) A METHOD OF SOLVING THE TIME DEPENDENT NEUTRON THERMALIZATION PROBLEM. J. U. Koppel (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Aug. 27, 1962. Contract AT(04-3)-667. 31p.

The method of singular eigenfunctions introduced first by Van Kampen and developed later by Case and Mika in connection with a one velocity transport problem, was adapted to solve the time and energy dependent infinite medium problem. The expansion of neutron density and scattering kernel in series of Hermite functions reduces the Boltzmann equation to a system of homogeneous linear equations. The resulting set of regular and singular eigen-

functions is shown to be complete and explicit formulas are found for the normalization integrals and Green's function. (auth)

24369 (GA-3542) INTEGRAL NEUTRON THERMALIZATION. Annual Summary Report, October 1, 1961–September 30, 1962. J. R. Beyster, J. R. Brown, H. C. Honeck, et al. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-167. 208p.

The L-band linear accelerator gave neutron yields per pulse of within a factor of two of the highest now available; operation was more than satisfactory. A pressure vessel to be used with the linac to measure neutron spectra of poisoned solutions for moderator temperatures up to about 600°F was constructed. A 150-kv positive-ion accelerator was added to the linac facility to produce 2.5 and 14-Mev neutrons from T(d,n) and d(d,n) reactions. The 14-Mev neutron yield is about 10^{11} neutrons/sec. Facilities for measuring neutron spectra were rearranged to eliminate systematic errors; reorientation of the 16-m detector bank necessitated remeasurement of the sensitivity of the bank as a function of neutron energy. Sensitivity of the 50-m bank was also remeasured. The effects on spectra of the scatterer, the location of pulsed neutron sources, the precollimator location and opening, and the linac intensity were also evaluated. To obtain information on the reliability of flux values predicted by standard transport theory approaches, angular dependent and scalar spectra were measured in 4- and 2-in. slab geometry and were compared with theoretical spectra. One-dimensional slab measurements were analyzed with the DSN and THERMOS codes. Results show that an anisotropic component of the scattering kernel is by far the most important refinement to the isotropic calculation. A multiplying assembly, nearly free of the large spatial effects induced by the external source, was constructed; and spectra were measured under distributed source conditions and compared with one-dimensional transport theory calculations. Neutron die-away was also studied. The feasibility of making spectral measurements by time-of-flight techniques in a system with a relatively long neutron die-away time was considered. Fluxes and spectra were obtained and compared with DSN calculations. Influence of various types of absorption, 1/v or resonance, on infinite-medium neutron spectra for various common moderators was studied. Spectra for various Sm compounds in H_2O were measured and compared with experimental and theoretical values; the total cross section of H_2O was obtained using Nelkin's kernel and Nelkin's kernel with Egelstaff's data; spectra for gadolinium chloride in H_2O were compared; and spectra for D_2O and polyethylene were considered. The thermal spectra in lithium hydride were also examined. The theoretical part of the integral thermalization program was concerned with the formulation of analytical descriptions of the scattering laws for low-energy neutrons. Comparisons between the predictions of these scattering laws and available differential scattering data were made. In addition, the theoretical scattering laws were used to calculate thermal-neutron spectra that were also compared with experimental data. The differential scattering cross section for neutrons on graphite was measured to determine the confidence with which the phonon frequency distribution can be derived. Spectra for anisotropic and isotropic graphite were computed. Thermalization of neutrons by zirconium hydride was investigated to determine the applicability of a model based on harmonic lattice vibrations. The model was found not to agree with experimental evidence. Evidence necessitating an alteration of Nelkin's model for neutron scattering by H_2O was developed. A scattering kernel for lithium hydride was calculated, and gave good agreement between experimental and theoretical neutron spectra. Asymptotic and transient spectra were computed for different moderators and scattering kernels by the times-moment method. The diffusion parameters of H_2O were studied, and the eigenvalue problem derived from the Boltzmann equation for neutrons approaching thermal equilibrium was considered. Modifications to the THERMOS, DSN, and ECTOPLASM codes were made, and the CERBERUS and CLAUDIUS codes were combined with the ORPHEUS code to give CORC. The new SPAN code in IBM-7090 FORTRAN for computing Westcott parameters for an experimental thermal neutron spectrum is discussed. A chopped-beam time-of-flight technique was used to measure the thermal neutron spectrum as a function of distance from a plane boundary separating contiguous regions with different absorption and temperature properties. Partial success was obtained in calculating the measured distributions. A technique for removing the epithermal component of a spectrum to measure a truly asymptotic spectrum was used with encouraging results. The build-up of modal amplitudes in pulsed subcritical assemblies and the Milne problem for a multiplying system were examined, and diffusion parameters obtained by the poisoning and the pulse techniques were compared. 58 references. (D.C.W.)

24370 (HW-77279) INTERSET—7090 CODE FOR INTERACTION MATRIX SETUP AND SOLUTION OF ARBITRARY CYLINDRICAL VESSEL SYSTEMS. Interim Report. F. R. Czerniejewski (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 15, 1963. Contract AT(45-1)-1350. 11p.

INTERSET is a code for approximating the physics of neutron interaction between cylinders with various heights and fuel concentrations, but of equal diameter. The radial albedo is calculated for systems of equal concentration; k_{eff} and albedoes are calculated for different fuel concentrations. Provision is also made to account for outside reflectors. Input and output for a sample problem are included. (auth)

24371 (IA-806) THE SNG-TAC CODE FOR THE PHILCO-2000 COMPUTER. M. Lemanska, G. Szwarcbaum, S. Yiftah, and P. Rabinovitz (Israel. Atomic Energy Commission, Rehovoth). Feb. 1963. 92p.

A description of the SNG method for the solution of the stationary transport equation in spherical geometry is given. The numerical process is outlined, and the SNG-TAC code prepared for the Philco Transac S-2000 computer in TAC mnemonic language is described. The SNG-TAC code was used for the calculation of several experimental critical assemblies. These calculations were compared with previous SNG calculations performed on an IBM 704 computer and with DSN calculations on the Philco-2000. (auth)

24372 (IFA/A/23) CORRECTIONS OF FINITE GEOMETRY AND ENERGY IN THE ANALYSIS OF FAST NEUTRONS POLARIZATION. I. Minzatu and A. Calboreanu (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1962. 20p.

A general method of experimental data correction for geometry and energy in fast neutron polarization experiments is given. The method is applied for the case of a geometry with axial symmetry. (auth)

24373 (WCAP-3709) COMPILATION OF A MUFT LIBRARY (LIBRARY 567). Robert A. Dannels and Dermot

J. Bredin (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Dec. 1962. Contract AT(30-1)-3064. 31p.

A description is given of the group cross sections required for a MUFT (or PIMG) library and of the techniques and literature used in obtaining them. For each element in a specific library (denoted as Library 567), the data sources and methods are listed. 43 references. (auth)

24374 STUDY OF NEUTRON DIFFUSION IN SINTERED BERYLLIUM OXIDE BY THE PULSE METHOD. I. F. Zhezherun. At. Energ. (USSR), 14: 193-9(Feb. 1963). (In Russian)

BeO, which is an excellent moderator material, possesses high heat resistance, has low absorption cross section, and provides for supplementary neutron multiplication by the $Be^9(n,2n)$ reaction, is considered a very promising material for high-temperature power reactors. In view of the contradictory data reported in the literature concerning the neutron-diffusion parameters in the sintered material, further thermal neutron-diffusion studies were undertaken using the pulsed-source method. A specimen previously used for determining the slowing-down length (Atomnaya Energ., 13: 258(1962)) was employed in this study. The values of the diffusion coefficient, diffusion length, transport length, effective transport cross section, absorption cross section, and the diffusion time were calculated and plotted. The calculated time of thermalization, 120 μsec, was considerably lower than the value reported in the literature; this might be due to the approximating assumptions used. (TTT)

24375 THE SPATIAL DISTRIBUTION OF THE NEUTRON RESONANCE ABSORPTION IN A BLOCK. V. A. Kremnev and A. A. Luk'yanov. At. Energ. (USSR), 14: 216-17(Feb. 1963). (In Russian)

Determination of the spatial distribution of the resonance absorption of neutrons in a block placed in the moderator is of importance for heterogeneous reactor theory and for the solution of special problems, such as the distribution of Pu in a U-bearing fuel element. The proposed method for the determination of the spatial and energy distribution takes into consideration the effect of neutron moderation in the block, inside the limits of the narrow resonance, making use of the corresponding functions of the monoenergetic transfer theory. The equations yield the spatial distribution of the neutrons after the first collision. Use was made of the formula given by G. Stuart (J. Nucl. Science and Eng., 2: 617(1957)) concerning the resonance absorption of individual levels for calculating the spatial distribution of the resonance absorption in a UO_2 cylinder with a radius of 0.5 cm at 300 and 0°C. The results agree well with the values reported by G. Smith, et al., (J. Nucl. Science and Eng., 9: 421(1961)). The final function derived represents the shielding coefficient which is dependent on the geometry of the block, the distance from the center of the block, and the concentration of the absorber. (TTT)

24376 NEUTRON DIFFUSION IN MOBILE MEDIA. A. A. Kostritsa. At. Energ. (USSR), 14: 218(Feb. 1963). (In Russian)

Entrainment of neutrons may be quite marked even at relatively low flow rates, regardless of the value of the neutron diffusion coefficient D and the scattering length l_s. This problem is of importance whenever the moderator is moved during the operation of the reactor; this effect might be more enhanced in some future designs. For this reason, the entrainment of monoenergetic, especially thermal, neutrons in a mobile medium was investigated. Equations derived for determining the neutron density changes indicated that the diffusion length L^* in a moving stream is larger than in a stationary one. If the difference between the two values exceeds 10%, an experimental determination is possible; this is the case for velocities of 3 to 3.5 m/sec in D_2O and 20 to 25 m/sec in H_2O. The entrainment can thus be derived from diffusion length measurements in mobile and stationary media. (TTT)

24377 ON THE CALCULATION OF THE COLLISION PROBABILITY IN REGULAR ROD LATTICES. H. Kiesewetter (VEB EPkA, Berlin). Kernenergie, 6: 106-13 (Mar. 1963). (In German)

The collision probability in regular lattices of cylindrical rods can be approached in the manner in which the collision probability in a cylindrical cell with equal volume is determined. At the cell border the boundary conditions for the angular distribution must be so formulated for externally incident neutrons that the neutron distribution in the rod lattice can be approximated very well by the model of the cylindrical cell. The condition with exact reflection on the cylindrical cell boundary according to Takahaski leads to systematic errors, which especially for wide lattices and large free paths in the region between the rods, can be observed. Better results are yielded by the conditions with isotropic reflection on the cylindrical cell boundary for which these errors do not appear. A method is given from which simple proximity formulas can be obtained. (tr-auth)

24378 THE EXPECTED NEUTRON SPECTRUM AS MEASURED BY MECHANICAL SELECTOR. Erzsébet Rupp and Gyula Loecs. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 11: 67-74(1963). (In Hungarian)

The expected number of neutrons per analyzer channel is given for the case of neutron-velocity-dependent neutron intensity. A closed formula is obtained for the expected number of neutrons assuming the intensity in terms of velocity to be constant. (auth)

24379 INVESTIGATION OF THE SCREENING CORRECTION FOR RESONANCE CAPTURE. Josef Christ, Siegfried Kornbichler, Doris Unger, and Tasso Springer (Technische Hochschule, Munich). Nukleonik, 5: 133-6 (Apr. 1963). (In German)

The influence of mutual screening of resonance-absorbing plates was investigated. A simple screening correction f can be calculated directly from information on the activation distribution function g(z). Besides g(z), the specific activation of a non-screened and partially irradiated plate depends on the depth of penetration z. The function can be determined theoretically or experimentally. The results for the correction for uranium agreed well with measurements. The correlation of the theory with the Dancoff correction is discussed. (tr-auth)

Nuclear Properties and Reactions

Refer also to abstract 24637.

24380 (AD-402668) THE NUCLEAR PROPERTIES OF RHENIUM. Final Technical Report. R. A. Karam, T. F. Parkinson, and W. H. Ellis (Florida. Univ., Gainesville). Mar. 1, 1963. Contract NOas 60-6021-c. 77p.

The thermal neutron activation cross sections of Re^{185} and Re^{187} were measured and found to be 96.5 ± 10 and 88 ± 14 b, respectively. The effective resonance integral of natural rhenium was measured to be 694 ± 28 b including the 1/v component. The (n,2n) cross sections of Re^{185}, Re^{187}, and $Re^{185}(n,2n)Re^{184m}$ at 14.1 Mev were measured and found to be 1.91 ± 0.6, 1.44 ± 0.41, and 1.12 ± 0.4 b, respec-

tively. The (n,α) reaction with 14.1 Mev neutrons was investigated theoretically, and it was concluded that this reaction does not occur. The (n,p) reaction was also investigated on a theoretical basis, and it was found that this reaction is improbable with 14.1 Mev neutrons. The cross section of this reaction was calculated to be 32.2 millib. This calculation, however, could be in error by a factor of 10. The capture gamma rays reported here are the work of Groshev. The decay scheme of $Re^{184}-Re^{184m}$ is proposed, and the gamma rays from Au^{196} and Au^{196m} were studied. Comparison of the shielding properties of rhenium and lead for thermal neutrons was made on a theoretical basis. A technique for separating gamma ray pulses from neutron pulses in NaI (Tl) detectors is also included. 43 references. (auth)

24381 (AD-403411) SPHERICAL NUCLEI WITH SIMPLE RESIDUAL FORCES. Technical Report No. 11. Parts I and II. Leonard S. Kisslinger (Western Reserve Univ., Cleveland) and Raymond A. Sorensen (Carnegie Inst. of Tech., Pittsburgh). Apr. 16, 1963. Contract Nonr-760(15) NR-012-202. 196p.

A detailed study on nuclei from Ni to Pb is carried out to determine the extent to which a method utilizing a nuclear model in which particles interact with a simple two-body force can be applied to spherical nuclei. The pairing hamiltonian is diagonalized by use of the quasi-particle transformation for neutrons and protons separately, and the neutron-proton short range force is discussed. The quasi-particle random phase approximation as applied to the quadrupole force is then outlined, and the results are compared with those of adiabatic perturbation theory. The results are compared with experimental energy level systematics, and the systematic binding energy data are examined. The static electromagnetic moments of the ground state and some excited states of nuclei are considered. Electromagnetic transition rates and systematic data on beta decay are also treated. Appendices give expressions for quasi-particles vector coupled to form tensor operators with the usual phases. Matrix elements used to calculate the magnetic dipole moments are given along with tables for the solution of pairing equations for the lowest few wave functions resulting from matrix-diagonalization of an odd-A nucleon interacting with a phonon. Magnetic moments of odd-neutron and odd-proton nuclei, quadrupole moments of odd-proton and odd-neutron nuclei; gyromagnetic ratios for phonons, B(E2) values for ground state transitions in even-even nuclei, and $B(E2)_{0^+\to 2}$, cross-over rates are listed. Plots show energy levels of isotopes, coupling parameters, reduction factors for transitions, and allowed transitions for various nuclei among other things. 36 references. (D.C.W.)

24382 (AEEW-R-131) CALCULATION OF THE FAST FISSION FACTOR FROM BASIC NUCLEAR DATA. A. J. Cochran and D. L. Reed (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Jan. 1963. 41p.

Using a two group model the ratio of U^{238} fissions to U^{235} fissions, and hence the fast fission factor, ϵ, is calculated from basic nuclear data in near natural uranium fuelled lattices. Proper account is taken of reflection of fast neutrons from the moderator and of interaction between rods in separate channels. Both these effects are shown to be significant. The calculated fission ratios are compared with the results of a number of experiments in graphite lattices. Agreement is excellent with some 20 metal rod experiments carried out at Harwell and at Brookhaven, the calculated values being within the experimental error for all except the largest rods. Although agreement is not uniformly good with four oxide cluster experiments carried out at Winfrith, the greatest discrepancy amounts to less than 0.3% in ϵ. (auth)

24383 (AEEW-R-226) DOPPLER BROADENING OF CROSS SECTIONS. P. A. C. Buckler and I. C. Pull (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Dec. 1962. 45p.

Expressions for temperature dependent cross sections in terms of resonance parameters are obtained, involving generalizations of the conventional Doppler functions, ψ and ϕ. Descriptions of Fortran sub-routines, which calculate broadened cross sections in accordance with the derived formulas, are included. (auth)

24384 (AERE-R-4237) TABLES OF FACTORS FOR CORRECTING FOR RADIOACTIVE DECAY. G. J. Hunter and Vera F. Mitchell (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Jan. 1963. 32p.

Tables of information required to derive factors to correct for the decay of Be^{7}, Cr^{51}, Fe^{59}, Co^{60}, Sr^{89}, Sr^{90}, Y^{90}, Zr^{95}, Nb^{95}, Mo^{99}, Ru^{103}, Ru^{106}, Ag^{110}, Ag^{111}, Sb^{124}, Sb^{125}, Te^{129}, I^{131}, Te^{132}, Cs^{134}, Cs^{137}, Ba^{140}, Ce^{141}, Ce^{144}, Ta^{182}, and Pa^{233} are given. In addition to decay factors for several intervals, disintegration constants and half lives are included. (D.C.W.)

24385 (AWRE-NR-3/63) STATISTICAL PROPERTIES OF THE EIGENVALUES AND EIGENVECTORS OF A NUCLEAR MODEL. N. MacDonald (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). May 1963. 15p.

Statistical properties of the eigenvalues and eigenvectors of the energy matrices of a nuclear model due to Raz are examined. Results for the eigenvalue distribution and the eigenvector component distribution differ from those for the matrices previously studied in this context. The differences correspond to the lack of plus-minus symmetry in the off-diagonal elements of the matrices, and to the preponderance of zero elements. Four different types of eigenvalue spacing distribution are compared with theoretical curves. The repulsion of energy levels is less marked in these results than in the theoretical curves. (auth)

24386 (BAW-1270) THORIUM RESONANCE INTEGRAL EXPERIMENT. Quarterly Technical Report No. 1, January–March 1963. W. G. Pettus, C. Samuel, and M. N. Baldwin (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3125. 21p. (EURAEC-691)

The geometric dependence of the effective resonance integral for Th and ThO_2 rods was investigated by an activation method. A procedure was developed for dissolving hard-fired ThO_2 pellets and separating out the Pa^{233} resulting from the decay of Th^{233} formed by the (n,γ) reaction in Th^{233}. The 310-kev gamma from Pa^{233} is used as a measure of the integrated neutron capture. The resonance integral can not be obtained, however, until necessary spectrum corrections and calibration measurements are made. Details of the sample irradiation and counting procedures that yielded results of high internal consistency are given. The Pa gamma spectrum is included. (auth)

24387 (HW-77296) THE HALF-LIFE OF PROMETHIUM-147. F. P. Roberts, E. J. Wheelwright, and W. Y. Matsumoto (General Electric Co. Hanford Atomic Products

Operation, Richland, Wash.). Apr. 1963. Contract AT(45-1)-1350. 10p.

The specific activity of Pm^{147} was determined by 4π beta counting known amounts of Pm to be $(2.026 \pm 0.048) \times 10^{15}$ dis/min/g, which corresponds to a half-life of 2.67 ± 0.06 yr. The chemical purity of the Pm was verified by emission and absorption spectroscopy and by chelometric titration. (auth)

24388 (IS-519) NUCLEAR MAGNETIC RESONANCE LINE SHAPES RESULTING FROM THE COMBINED EFFECTS OF NUCLEAR QUADRUPOLE AND ANISOTROPIC SHIFT INTERACTIONS. I. THEORY. W. H. Jones, Jr., T. P. Graham, and R. G. Barnes (Ames Lab., Ames, Iowa). [July 25, 1962]. Contract [W-7405-eng-82]. 30p.

Theory for the effects of nuclear quadrupole and anisotropic shift interactions on nuclear magnetic resonance are reviewed, and theory for their combined effects is presented. Characteristics of the nmr of a nucleus for each of the three situations are given. Line-shape patterns for various relative strengths of the two effects in polycrystalline samples are presented, and the behavior of various experimentally observed quantities (line widths and shifts) are calculated as functions of resonance frequency for some combinations of values of the quadrupole and shift parameters typical of those already observed. (D.C.W.)

24389 (JINR-P-1209) DVUKHKVAZICHASTICHNYE UROVNI I VEROYATNOSTI β-PEREKHODOV V IZOTOPAKH Sm, Gd I Dy. (Two-Quasi-Particle Levels and β-Transition Probabilities in the Sm, Gd, and Dy Isotopes). N. I. Pyatov and V. G. Solov'ev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 11p.

The spectra and β-transition probabilities in the nuclei with A < 160 were calculated by using new data on the spectra of odd nuclei in this region. The results obtained are in good agreement with the experimental data and allow a further analysis of the nuclear spectra in this region. (auth)

24390 (JINR-P-1216) VYCHISLENIE MOMENTA INERTSII CHETNO-CHETNYKH YADER NA OSNOVE SVERKHTEKUCHEI MODELI. (Calculation of the Moment of Inertia of Even-Even Nuclei According to the Superfluid Model). Liu Yuan (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 7p.

A detailed calculation of the moment of inertia of the ground and excited states was made on the basis of the superfluid model. Theoretical results and experimental data do not contradict. All the results obtained show that: the superfluid nuclear model describes, in the main, truly general behavior of the moment of inertia from one state to another, from a nucleus to a nucleus; in calculating the moment of inertia of the ground state, the blocking effect is not essential; in calculating the moment of inertia of the two-quasi-particle excited state, it is necessary to take into account the contribution of the four quasi-particle excited states. (auth)

24391 (JINR-P-1238) UGLOVOE RASPREDELENIE PRODUKTOV REAKTSII PEREDACHI. (Angular Distribution of Transfer Reaction Products). B. N. Kalinkin and Ya. Grabovskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 16p.

The angular distribution of the transfer reaction products is calculated on the basis of the assumption about the quasi-elastic character of collision of ions with the target nucleus. In this case use is made of the information about the parameters of the nuclear interaction between colliding nuclei obtained from the quasi-classical analysis of experiments on heavy-ion elastic scattering. Results are in good agreement with experimental data. (auth)

24392 (LAMS-1739) TABLE OF THE RACAH AND Z COEFFICIENTS. Max Goldstein and Chester Kazek, Jr. (Los Alamos Scientific Lab., N. Mex.). Oct. 1954. Contract W-7405-eng-36. 156p.

A table of the Racah and Z coefficients, W(LJLJ, jλ) and Z(LJLJ, jλ) for two of the six indices identical is given for: j = 0 ($\frac{1}{2}$) $13\frac{1}{2}$; L = 0 ($\frac{1}{2}$) $17\frac{1}{2}$; J = |L-j|, |L-j+1|, . . . , (L+j); and λ = 0 (2) 16. (auth)

24393 (LNF-63/15) NUCLEAR DYNAMIC POLARIZATION. Note No. 187. V. Montelatici (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Mar. 21, 1963. 11p.

The nuclear dynamic polarization steady state is described from the thermodynamical and statistical view point. It is shown how the nuclear population in some cases is inverted giving rise to a radiofrequency amplification by stimulated emission. (auth)

24394 (NAA-SR-Memo-8274) A MULTIGROUP LIBRARY OF ABSORPTION CROSS SECTIONS FOR NATURAL SAMARIUM IN ZIRCONIUM HYDRIDE MODERATED REACTORS. R. H. Norman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 21, 1963. Contract [AT(11-1)-Gen-8]. 11p.

A multigroup library of absorption cross sections for samarium to be used with the ULCER, QUICKIE, and FAIM codes is presented. The methods of calculation discussed depend on the particular energy region under consideration. In the thermal energy range the zirconium hydride spectrum for the SNAP 2/10A core is computed with the QUICKIE code and is used in flux-weighting cross sections based on BNL-325 data. In the epithermal and intermediate energy range, infinitely dilute resonance integrals are calculated by weighting the Breit-Wigner single-level resonance cross section with a 1/E flux spectrum. Unresolved resonances are accounted for by graphical integration of the BNL-325 curve. It is necessary to include the 1/V contribution to σ_a in the resonance region as a consequence of the approximation $E_0 \simeq E$ in integrating the Breit-Wigner formula. In a large part of the fast energy region, the absorption cross section as reported in BNL-325 is assumed to be zero. (auth)

24395 (ORNL-3433) DESCRIPTION OF PRINTED OUTPUT FROM INTRANUCLEAR CASCADE CALCULATION. H. W. Bertini (Oak Ridge National Lab., Tenn.). May 28, 1963. Contract W-7405-eng-26. 96p.

A detailed description of the printed output sheets from the intranuclear cascade calculation described in ORNL-3383 is given. The three analysis codes—analysis codes I and II and an evaporation code—that were written to organize the raw data of the output tape are considered. (auth)

24396 (ORNL-TM-556) TABULATION OF THE NEUTRON TOTAL CROSS SECTION OF U^{233} FROM 0.07 TO 10,000 ev MEASURED WITH THE ORNL FAST CHOPPER. N. J. Pattenden and J. A. Harvey (Oak Ridge National Lab., Tenn.). Apr. 30, 1963. Contract [W-7405-eng-26]. 34p.

A tabulation of the neutron total cross section of U^{233} as a function of neutron energy from 0.07 to 10,000 ev, measured with the ORNL fast chopper time-of-flight neutron spectrometer is given. (auth)

24397 (SCR-245A) TABLE OF ATOMIC MASSES. J. W. Guthrie, ed.—R. L. Heath, comp. (Sandia Corp., Albuquerque, N. Mex.). Sept. 1959. Revised Apr. 1963. Contract AT(29-1)-789. 306p.

Isotopic masses converted to the C^{12} = 12.000000 scale are given along with the square roots of the masses and the relative abundances of the isotopes. Abundances are normalized to an apparent abundance of 100% for the most abundant isotope. (D.C.W.)

24398 (TID-16262) NUCLEAR MAGNETIC MOMENTS OF W^{183}, Os^{187} AND Fe^{57}. Richard R. Chasman (Argonne National Lab., Ill.). May 1962. Contract [W-31-109-eng-38]. 12p. (UAC-6465)

The single particle wave functions of an asymmetric harmonic oscillator potential are used to calculate the nuclear magnetic moments of Fe^{57}, Os^{187}, and W^{183}. Energy level spacings for W^{183} are also calculated using this potential with an asymmetric rotor hamiltonian. Results of the magnetic moment calculations and subsequent comparisons show that an asymmetric oscillator potential describes the physical situation better than an axially symmetric oscillator. Also, a discrepancy between the single particle potential used in the W^{183} calculations and the hydrodynamic model's method of computing rotational moments of inertia is noted. (D.C.W.)

24399 (TID-16300) THE GROUND STATE OF F^{20}. Dieter Kurath (Washington. Univ., Seattle). [Aug. 1962]. Contract [AT(45-1)-1388"B"]. 13p.

It is shown that in order to describe some properties of the F^{20} ground state, the K = 1 and K = 2 states of the Nilsson model must be strongly mixed. The primary ingredient in the description is therefore the rotational Coriolis term rather than the interaction between the odd neutron and odd proton. (auth)

24400 (TID-16301) SCATTERING FROM A SPHERICAL DEFORMABLE NUCLEUS. John G. Willis (Washington. Univ., Seattle). [Aug. 1962]. Contract [AT(45-1)-1388"B"]. 24p.

The scattering of a spinless neutral particle from a spherical deformable nucleus is considered in detail. The nucleus is assumed to perform collective harmonic monopole vibrations that allow direct inelastic scattering through an optical model interaction. Numerical solutions of the coupled Schrödinger equations are obtained. Cross sections for exciting states involving single and double phonon excitations are calculated and compared with the predictions of adiabatic, distorted wave, and plane wave Born approximations. The adiabatic approximation is able to account for the relative phases of the elastic and inelastic angular distributions although the magnitudes of the cross sections are larger at large angles than those given by solving the coupled equations. It is demonstrated that while the distorted wave approximation is valid for single excitation processes it fails to give even a qualitatively correct result when applied to inelastic scattering involving double excitation unless plane wave Born approximation is also valid. (auth)

24401 (TID-16939) RELATIVE CROSS SECTIONS FOR FORMATION OF THE SHIELDED ISOMERIC PAIR Cs^{134m} AND Cs^{134} IN MEDIUM ENERGY FISSION. R. Vandenbosch and H. Warhanek (Argonne National Lab., Ill.). July 1962. Contract [W-31-109-eng-38]. 18p. (UAC-6654)

The cross section ratio of Cs^{134} and Cs^{134m} was measured for the fission of U^{233}, U^{235}, and U^{238} induced by helium ions of 42 Mev and by helium ions of lower energy, for fission of U^{235} induced by deuterons of 21 Mev, and for fission of U^{233} induced by γ rays with an energy of up to 16 Mev. Comparison of the results with calculations based on a statistical theory of the spin distribution of level densities in excited nuclei shows that in the case of low angular momentum of the fissioning nucleus (γ-ray induced fission) the fragments are produced with a mean intrinsic angular momentum that is larger than the angular momentum of the fissioning nucleus. It also shows that increased angular momentum of the fissioning nucleus (helium ion induced fission) is at least partially transferred into additional intrinsic angular momentum of the fragments. Measurements of the angular dependence of the isomer ratio gave for the 170 to 90° ratio no significant deviation from isotropy. The half life of Cs^{134m} was remeasured and found to be 2.91 ± 0.02 hr in agreement with earlier results. 27 references. (auth)

24402 (TID-18633) THE INTERACTION OF DEUTERONS WITH NITROGEN 14. Richard Frank Seiler (Ohio State Univ., Columbus). 1963. Contract AT(11-1)-605. 145p.

Absolute cross section measurements for the reaction $N^{14}(d,d)N^{14}$ were made using a differentially pumped gas scattering chamber. A solid state surface barrier counter was used to resolve the elastic deuterons from the many reaction groups. Cross section measurements were made as a function of the incident deuteron energy at center of mass angles of 90, 125, 140.8 and 166° for deuteron energies from 0.7 to 2.0 Mev and at angular distributions every two hundred kv over the energy range from 0.70 to 2.10 Mev. Analysis of the experimental data was based upon two different theoretical approaches, the compound nucleus single level formalism and the optical model. Compound nucleus calculations, under quite restrictive assumptions, demonstrate that it is not possible to fit the experimental data by assuming resonant contributions from two levels with different spins and parities. The optical model fits to the data are, in general, good, but the behavior of the model parameters that produce good fits vary by approximately 20% over the 1.4 Mev energy range investigated. The variation of the optical model parameters can be interpreted as an indication that compound nuclear effects cannot be neglected. Cross sections and attempts at fitting them are graphically displayed; Fortran programs used in the cross section calculations are listed. 59 references. (auth)

24403 (UCRL-10414) SIMPLIFIED SHELL-MODEL ALPHA DECAY RATE CALCULATIONS NEAR Pb^{208}. John O. Rasmussen (California. Univ., Berkeley and California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1962. Contract W-7405-eng-48. 27p.

Simplified formulas approximating the shell-model theoretical results of Mang and of Harada are derived and tested. Numerical calculations of alpha reduced widths from ground and excited states of Po^{212} are made using wave functions of Band, Sliv, and Kharitonov. The calculated reduced widths for decay from Po^{212} excited states are lower than the width from ground by factors ranging from 4–7 except that the second excited 2+ state shows a very small width. The usual analyses of long-range alpha intensities to derive excited state lifetimes must be modified, making the lifetime estimates longer by the appropriate hindrance factor. (auth)

24404 (UCRL-10456) THE DISCOVERY OF A NEW FERMIUM ISOTOPE. Raymond C. Gatti, Reinhard Brandt, Llad Phillips, and Stanley G. Thompson (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 13, 1962. Contract W-7405-eng-48. 7p.

A new spontaneous-fission activity was observed in a fermium fraction separated from 120 mg of mixed curium isotopes that were subjected to an integrated flux of 2.4×10^{22} neutrons/cm^2 at the Materials Testing Reactor, Idaho Falls, Idaho (MTR). A least-squares analysis of the

spontaneous-fission decay data yielded a half life of 10.8 days with a standard deviation of about $(^{+2.2}_{-1.8})$ days. An estimated half life of (11^{+10}_{-6}) days is reported here. The mass assignment is uncertain, but limited to A = 258 or 257. (auth)

24405 (UCRL-10464) SPONTANEOUS-FISSION HALF LIVES OF Cf^{254}, Fm^{255}, AND Cf^{250}. Llad Phillips, Raymond C. Gatti, Reinhard Brandt, and Stanley G. Thompson (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 13, 1962. Contract W-7405-eng-48. 7p.

The remeasured spontaneous-fission half life of Cf^{254} is 60.5 ± 0.2 days. The spontaneous-fission half life of Fm^{255} is determined to be $(1.0^{+0.6}_{-0.3}) \times 10^4$ y. The remeasured alpha-to-fission ratio in the decay of Cf^{250} is (1330 ± 45). The remeasured electron-capture/β decay branching ratio in E^{254m} is (0.078 ± 0.006)%. (auth)

24406 (WAPD-TM-333) TIME-DEPENDENT FISSION-PRODUCT THERMAL AND RESONANCE ABSORPTION CROSS SECTIONS. T. R. England (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1962. Contract AT(11-1)-Gen-14. 67p.

With the advent of increasing reactor lifetimes, the need for an accurate description of all fission product cross sections developed in an operating reactor is apparent. An exact analytical method is outlined by which the detailed time-dependent concentration of each fission product and other generated nuclides can be calculated. Radioactive decay and neutron absorption in the time-dependent reactor flux are explicitly included. In addition to U^{235} several fissile nuclides may simultaneously provide a source to the fragment concentrations. The method is demonstrated by calculating both the individual and total thermal and resonance cross sections per fission of 163 fission products from U^{235}, natural uranium, enriched uranium, and Pu^{239} in a variety of irradiation flux histories and spectra. All known fission products of significance, i.e., those formed by direct fission yields and their progeny formed by neutron absorption and radioactive decay, are included in the analysis. This is in contrast to treatments heretofore that have largely ignored coupling systematics. A comparison of the aggregate absorption cross sections, determined by both calculation and experiment for a highly enriched sample, which has been irradiated in the MTR to 81% U^{235} depletion, shows agreement within 2% thermally and 15% epithermally. (auth)

24407 HALF LIVES OF CESIUM-137 AND CESIUM-134 AS MEASURED BY MASS SPECTROMETRY. L. A. Dietz, C. F. Pachucki, and G. A. Land (General Electric Co., Schenectady, N. Y.). Anal. Chem., 35: 797-9(June 1963).

Mass spectrometric measurements of radioactive decay rates over a period of 1½ years indicate a half life of 30.35 ± 0.38 years for Cs^{137} and 2.046 ± 0.004 years for Cs^{134}. However, precisions quoted as standard deviations are considered to be preliminary values. (auth)

24408 INELASTIC SCATTERING OF He^3 AND He^4 BY CARBON AND NEON. J. Anguilar, J. B. A. England, and A. Garcia (Univ. of Birmingham, [Eng.]; Facultad de Ciencias, Valencia; and Facultad de Ciencias, Madrid). Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 58: 319-26(Nov.-Dec. 1962). (In Spanish)

Differential cross sections for the inelastic scattering of 28.5-Mev He^3 particles by the nuclei C^{12} and Ne^{20}, and of 38-Mev α particles by C^{12} were measured using the photographic technique. The $C^{12}(He^3,\alpha)C^{11}$ reaction was also observed. The corresponding angular distributions were compared with the predictions of the Austern-Butler-McManus direct-interaction theory. (auth)

24409 THE DETERMINATION OF THE NUCLEAR PAIR CORRELATION FUNCTION AND MOMENTUM DISTRIBUTION. Kurt Gottfried (Harvard Univ., Cambridge, Mass.). Ann. Phys. (N. Y.), 21: 29-46(Jan. 1963).

A critical discussion of some of the suggestions that have been put forward for measuring the nuclear momentum distribution F(p) and pair correlation function $C(r_1r_2)$. On the basis of qualitative arguments, it is concluded that a majority of the measurements of F and C are based on dubious analysis of the experimental data. In particular, the use of the impulse approximation in these analyses is brought into question. Although the conclusion that F(p) has many high momentum components is not questioned, a lack of reliable quantitative knowledge regarding F(p) at this time is argued. Various experiments related to the measurement of C, in particular inelastic electron scattering, and the (γ, pn) reaction are discussed. Some rigorous formulas for the cross sections measured in pursuit of F and C are also given. (auth)

24410 INELASTIC ELECTRON SCATTERING FROM FLUCTUATIONS IN THE NUCLEAR CHARGE DISTRIBUTION. Wieslaw Czyz (Inst. for Theoretical Physics, Copenhagen and Instytut Fizyki Jadrowej, Krakow) and Kurt Gottfried. Ann. Phys. (N. Y.), 21: 47-71(Jan. 1963).

The cross section $\sigma(q, \omega)$ for scattering of electrons through momentum transfer q and energy loss ω from heavy nuclei is examined. This cross section is related to the four-dimensional Fourier transform of the nuclear time-dependent pair correlation function; this latter function gives a measure of the fluctuation of the charge density about its mean value. In an infinite medium there are regions of the q-ω plane where scattering is possible only if dynamical (in contrast to statistical) correlations are present. An argument is presented that leads to the conclusion that even for finite nuclei there is still a fairly well defined boundary outside of which the scattering is due solely to correlations impressed on the ground state by the nuclear forces. Since such experiments would only be carried out on heavy nuclei, the break down of the Born approximation is also discussed, and it is concluded that corrections can readily and reliably be made for this. A general discussion of some possible methods for computing the relevant correlation function is given. A detailed calculation of the cross section $\sigma(q, \omega)$ for scattering from a gas of nucleons with hard core interactions is also presented. This calculation is expected to give the qualitative features of the cross section for real nuclei when the values of q and ω are properly chosen. Furthermore, it leads to estimates of the relative importance of various diagrams that should be useful in calculations with more realistic nuclear models. 35 references. (auth)

24411 DIRECT AND COMPOUND NUCLEUS EFFECTS IN NUCLEAR PHOTODISINTEGRATION. Carl Shakin (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 22: 54-67(Apr. 1963). (TID-17962)

A modified form of unified theory of nuclear reactions is used to construct the correct final state for the calculations of photodisintegration. The reaction theory used satisfies the requirements of the Pauli Principle. Further, a correlation is made between resonance phenomena and shell model states whose energies are determined to lie in the continuum of the complete nuclear Hamiltonian. The calculated cross-sections include, in addition to the usual Breit-Wigner expression, another contribution that may be termed direct. It is important to note that the direct contribution to

the cross section exhibits resonant behavior simultaneously with the Breit-Wigner expression. (auth)

24412 LEVEL SPECTRA OF A = 6 NUCLEI FROM THE FREE NUCLEON-NUCLEON INTERACTION. J. F. Dawson and J. D. Walecka (Stanford Univ., Calif.). Ann. Phys. (N. Y.), 22: 133-64(Apr. 1963).

The calculational procedure recently discussed by Dawson, Talmi, and Walecka for calculating level spectra of double-magic-plus-two-nucleon nuclei from the free nucleon–nucleon interaction is applied to the A = 6 system. A Bethe-Goldstone equation is written for the two external nucleons and by working within a harmonic oscillator framework, the equation can be transformed to relative coordinates and solved. The free nonsingular nucleon–nucleon interaction is found to give a good fit to all the known levels, and the more sophisticated Brueckner-Gammel-Thaler, and Hamada potentials are found to give essentially the same results, after careful examination of the effect of the strong tensor coupling in the T = 0 states. This, in a sense, justifies previous calculations of spectra of light nuclei with nonsingular interactions. Excessive absolute binding energy is found, presumably because of our use of harmonic oscillator single-particle potentials. Good agreement is found for the magnetic moment of Li^6 and the ft value for the ground state β decay $He^6 \rightarrow Li^6$ and also for the quadrupole moment of Li^6, using the more complicated potentials. (auth)

24413 ELECTRON RADIATIVE TRANSITIONS IN A COULOMB FIELD. W. J. Karzas and R. Latter (RAND Corp., Santa Monica, Calif.). Astrophys. J., 6: Suppl. Ser., 55, 167-212(May 1961).

Free-free, bound-free, and bound-bound Gaunt factors and oscillator strengths were computed for electrons in a pure Coulomb potential. Numerical results are presented for a wide range of electron and photon energies. In addition, for the free-free case, average Gaunt factors and the rate of bremsstrahlung production were obtained as functions of temperature for a Boltzmann distribution of electron energies. (auth)

24414 INVESTIGATION OF NUCLEAR REACTIONS WITH THE CYCLOTRON OF THE PHYSICAL INSTITUTE OF THE UKRAINIAN ACADEMY OF SCIENCES. O. F. Nemets, M. V. Pasechnik, and N. N. Pucherov. At. Energ. (USSR), 14: 159-70(Feb. 1963). (In Russian)

The work carried out with the cyclotron of the Physical Institute during the period from 1957 to 1961 is summarized. The cyclotron generates a 6.8-Mev proton and a 13.6-Mev deuteron beam. The elastic and inelastic scattering of the 6.8-Mev protons on targets consisting of the natural isotopic mixtures of Al, Fe, Co, Ni, Cu, Zn, Ag, Cd, Sn, Pb, and Bi was studied. Similar investigations were also carried out on the following separated isotopes: $Ni^{58,60,62,64}$, $Cu^{63,65}$, $Zn^{64,68,70}$, $Zr^{90,91,92,96}$, and $Sn^{116,117,119,124}$. Study of the angular and energy distribution of protons in the deuteron-stripping reactions of Be^9, C^{12}, $Si^{28,29}$, Ca^{40}, $Ti^{46,47,48}$, $Ni^{58,60,62,64}$, Sr^{88}, $Zr^{90,91}$, $Mo^{91,92,95,98}$, $Cd^{111,113}$, and $Sn^{117,119}$ nuclei made it possible to determine the spin and the parity of the ground and excited states of the isotopes. Study of the interaction of protons and deuterons with the isotopes made it possible to investigate the isotopic effect in the elastic scattering process at large angles, using isotopes which differ from each other by one or two neutrons. (TTT)

24415 A METHOD FOR STUDYING THE FISSION PROCESS AT A SPECIFIC EXCITATION ENERGY OF THE COMPONENT NUCLEUS. V. M. Pankratov and V. M. Strutinskii. At. Energ. (USSR), 14: 171-6(Feb. 1963). (In Russian)

An investigation of the fission due to charged particles and neutrons with energies in the range of several tens of Mev's may help to clarify the effect of the excitation energy of the nucleus on the fission process, but emission of one or several neutrons complicates the interpretation of the results. A "subtractive" method is proposed for the study of fission phenomena, such as the mass distribution of the fission fragments and the kinetic energy distribution at certain given excitation energies of the nucleus. As an example, the experimental data of the fission of U^{233} and Th^{232} by α particles, obtained by the time-of-flight method, are analyzed. It is shown that at an energy of about 25 Mev of the fissioning nucleus, the fission is asymmetrical and that the dip of the kinetic energy for symmetric fission is preserved. (TTT)

24416 FISSION CROSS SECTIONS OF THORIUM-232, URANIUM-233, URANIUM-235, NEPTUNIUM-237, AND URANIUM-238 BY NEUTRONS WITH ENERGIES IN THE RANGE OF 5 TO 37 Mev. V. M. Pankratov. At. Energ. (USSR), 14: 177-84(Feb. 1963). (In Russian)

The results of the fission cross section measurements of certain Th, U, and Np isotopes in the energy ranges 3 to 10 and 10 to 22 Mev, carried out with ionization fission chambers and gas scintillation fission counters, were presented previously. The scope of these measurements was extended to the 22- to 37-Mev range for U^{232} and U^{238}, the 22- to 27-Mev range for U^{235} and Np^{237}, and the 10- to 22-Mev range for U^{233}. Supplementary measurements were carried out at lower neutron energies, increasing the precision of the absolute cross section values. The 1.5-m cyclotron of the I. V. Kurchatov Institute was used for the experiments. The neutrons were generated by the D(d,n)He^3 and the T(d,n)He^4 reactions, making use of the time-of-flight method for selecting neutrons with the desired energy, and employing gas scintillation fission counter detectors. Calculations on the probability of fission indicated that the fissionability corresponds to an excitation energy of about 8 to 10 Mev of the intermediate nuclei; however, the close agreement with fissionability values obtained in measurements carried out with 3-Mev neutrons is not accidental, inasmuch as at neutron energies of about 20 Mev they are captured by nuclei having orbital moments of the order of 10. (TTT)

24417 THE EFFECT OF THE NUCLEON PARITY NUMBER ON THE RADIATIVE CAPTURE CROSS SECTION. T. S. Belanova and O. D. Kazachkovskii. At. Energ. (USSR), 14: 185-92(Feb. 1963). (In Russian)

An attempt was made to determine the capture cross section of even-odd nuclei, σ_c(e-o), on the basis of the capture cross section of activated even-even nuclei, σ_c(e-e), of the isotopes, derived from the total cross section values, σ_a, of the natural isotopic mixtures. Although the (e-e) concentration is very small in natural isotopic mixtures, the calculation does not yield too high errors because the σ_c(e-p) values are high. On this basis, the fast neutron cross section values for the level below 1 Mev were calculated from existing experimental data. The values obtained exceeded by several times the corresponding values for nuclei with an even number of neutrons, for both even and odd Z numbers. The results do not agree with the characteristic level concept of H. Hurwitz and H. Bethe (Phys. Rev., 81: 898(1951)), according to which binding energy oscillations are excluded because of the parity of the nucleons in the nucleus. (TTT)

24418 TWO-LEVEL APPROXIMATION FOR THE THEORY OF NUCLEAR REACTIONS. C. Mahaux (Université, Liege). Bull. Soc. Roy. Sci. Liege, 32: 240-51 (1963). (In French)

A two-level approximation without background was introduced in the complex eigenvalue theory of nuclear reactions. The resulting formula for the cross section was compared with the corresponding one in the R-matrix theory. Generalization to the n-level case is discussed. The connection between the resonance wave functions and the eigenfunctions of the R-matrix theory is examined. (auth)

24419 CALCULATIONS OF REDUCED PROBABILITY FOR E2 TRANSITIONS IN BETA AND GAMMA BANDS. M. A. Preston and D. Kiang (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 41: 742-9(May 1963).

For convenience in analysis of experiments on nuclear energy levels, specific formulas are listed for the reduced probabilities of E2 transitions between rotational levels built upon β and γ-vibrational bands for axially symmetric even-even nuclei. (auth)

24420 NUCLEAR CHARGE DISPERSION IN THE HIGH-ENERGY FISSION OF URANIUM. J. H. Davies and L. Yaffe (McGill Univ., Montreal). Can. J. Phys., 41: 762-83(May 1963).

The independent formation cross sections of Cs^{130}, Cs^{132}, Cs^{134}, Cs^{136}, Cs^{138}, Rb^{86}, Nb^{95m}, Nb^{96}, and Nb^{97} produced in the fission of natural uranium by protons were measured radiochemically at incident proton energies ranging from 10 to 85 Mev. The excitation functions correlate well with those obtained by Friedlander, Friedman, Gordon, and Yaffe. Charge dispersion curves were constructed at 20, 36, 50, 65, and 80 Mev. The curves broaden with increasing proton energy and the most probable charge approaches the line of β-stability. An explanation for both of these effects is given in terms of spallation-fission competition. (auth)

24421 THE 6.48-Mev LEVEL OF C^{11}. D. W. Braben, P. J. Riley, and G. C. Neilson (Univ. of Alberta, Edomonton). Can. J. Phys., 41: 784-92(May 1963).

The 6.48-Mev level of C^{11} was studied by means of the $B^{10}(d,n\gamma)C^{11}$ reaction using time-of-flight techniques. The results show that the ratio of the ground-state transition to the cascade via the second excited state of C^{11} is 8 ± 1:1. Comparison is made with the predictions of the intermediate-coupling model. (auth)

24422 ERRATA TO "TIME-OF-FLIGHT FISSION STUDIES ON U^{233}, U^{235}, AND Pu^{239}." J. C. D. Milton and J. S. Fraser (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 41: 817-19(May 1963). (AECL-1618)

A numerical mistake was discovered in the average velocities presented in the paper "Time-of-Flight Fission Studies on U^{233}, U^{235}, and Pu^{239}" (NSA 17: 5334). A revised table is presented. (C.E.S.)

24423 THE SPIN OF INDIUM-117. J. A. Cameron and R. G. Summers-Gill (McMasters Univ., Hamilton, Ont.). Can. J. Phys., 41: 823-6(May 1963).

The nuclear spin of the 45-min ground state of In^{117} was measured by atomic-beam magnetic resonance. Atomic beams containing In^{117} were formed and resonances were sought at frequencies corresponding to a number of high spin values in the $^2P_{\frac{1}{2}}$ electronic state. Runs were carried out at magnetic fields of 10, 15, 20, and 36 gauss. The assignment $I = \frac{9}{2}$ was made to this isotope in agreement with a previous shell-model prediction. (C.E.S.)

24424 INTERNAL CONVERSION ELECTRON SPECTRUM OF THE DECAY $Pm^{151} \rightarrow Sm^{151}$. Georges Marguier and Andrée Juillard (Institut de Physique Nucleaire, Lyon; Faculté des Sciences, Grenoble, France; and CEN, Grenoble, France). Compt. Rend., 256: 3053-5(Apr. 1, 1963). (In French)

An iron-free, double-focusing β spectrometer was used to study the internal conversion spectrum in the $Pm^{151} \rightarrow Sm^{151}$ decay. It was possible to detect and determine the nature of the following low-intensity transitions: 25.65, 35.04, 38.09, 76.17, 101.9, 156.2, 162.82, 167.94, 227.8, and 236.9 kev. These transitions have not been previously reported. The rays observed by Rutledge et al. (Phys. Rev., 86: 775(1952)) were restudied. (tr-auth)

24425 A PRECISE DETERMINATION OF THE THERMAL NEUTRON ABSORPTION CROSS SECTION OF B^{10} AND NATURAL BORON BY TIME OF FLIGHT. A. Prosdocimi (Euratom, Geel, Belg.) and A. J. Deruytter. J. Nucl. Energy, Pts. A and B., 17: 83-7(Feb. 1963).

The total cross section of B_2O_3 was measured from 0.006 to 0.082 ev with the BR-1 slow-chopper. Samples of natural boron with an isotopic abundance of (19.81 ± 0.02) per cent B^{10} atoms, and boron enriched up to (96.515 ± 0.013) per cent were used for these measurements. From the accurate total cross-section values obtained, the ratio of the boron absorption cross section to the reciprocal of neutron velocity was calculated. This quantity remains a constant over the entire energy range covered and its mean value for natural boron is K = (1.674 ± 0.0041) barns m/μsec and for the enriched boron K = (8.15 ± 0.019) barns m/μsec. The deduced values for the boron absorption cross section at the reference neutron velocity of 2200 m/sec are for natural boron σ_a = 760.8 ± 1.9 barns and for the enriched boron σ_a = 3703 ± 8.9 barns. These values yield for the absorption cross section of the B^{10} isotope at the reference velocity 3840 ± 11 barns as deduced from the natural boron results, and 3837 ± 9 barns from the enriched sample. (auth)

24426 (p,n) REACTIONS AT MEDIUM ENERGY. G. Albouy, M. Gusakow, N. Poffe, H. Sergolle, and L. Valentin (CNRS, Bellevue, France). J. Phys. Radium, 23: 1000-2(Dec. 1962). (In French)

The excitation functions of the (p,n) reaction on B^{11}, V^{51}, Cu^{65}, Sr^{88}, and La^{139} were determined at 40 to 150 Mev. The experimental technique used for the irradiation and the methods used for the chemical separation of Zn and Cr (formed from Cu and V, respectively) are described. The results obtained with the probable errors are shown and compared with theoretical predictions. A satisfactory agreement was found between the experimental and theoretical results. The reaction mechanism, above 80 Mev, is essentially a simple cascade produced probably in the entire nuclear volume. (J.S.R.)

24427 STRUCTURE OF GIANT RESONANCE IN THE $P^{31}(p,\gamma)$ REACTION. M. Kimura, K. Shoda, N. Mutsuro, et al. (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 18: 477-82(Apr. 1963).

The variation of the cross section for $P^{31}(p,\gamma_0)$, $(p,\gamma_1)S^{32}$ reactions with proton energy from 7.8 to 14.2 Mev, were measured using 4"ϕ × 4" NaI(Tl) crystal spectrometers. The gamma rays corresponding to the transitions to the ground and first excited state of S^{32} showed giant resonance with complicated structures. The resonance of (p,γ_0) falls off at about 13 Mev with full width of about 7 Mev if Harwell's result is combined. The resonance of (p,γ_1) does not show indications of fall-off at least up to about 14 Mev. Some results on $Cu^{65}(p,\gamma)$ are also mentioned. (auth)

24428 EXPERIMENT ON $Fe^{54}(p,\gamma)Co^{55}$ REACTION. Kun-Kuang Huang, Sinji Matumoto, Masayuki Sekiguchi, Hajime Ohnuma, Akira Sugawara, and Yozo Nogami (Tokyo Univ.). J. Phys. Soc. Japan, 18: 594-5(Apr. 1963).

The reaction $Fe^{54}(p,\gamma)Co^{55}$ was studied in the energy range of 770–110 kev. Resonance levels of Co^{55} were observed at 883, 961, and 1107 kev. The energies and intensities of observed gamma rays are also presented. (C.E.S.)

24429 SOME INVESTIGATIONS FOR PREPARATION OF CARRIER-FREE Be^7 FROM LITHIUM WITH DEUTERONS IN THE CYCLOTRON. K. Wagner (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 121-2(Mar. 1963). (In German)

For determination of the formation rate of Be^7 from lithium with deuterons at 13.5 Mev, lithium magnesium borate was irradiated in the Rossendorfer cyclotron so that the nuclear reaction $Mg^{24}(d,\alpha)Na^{22}$ could serve as an inner standard. The found value amounted to 76 mC/ma hr. (tr-auth)

24430 SOME INVESTIGATIONS FOR PREPARATION OF CARRIER-FREE Bi^{206} FROM LEAD WITH DEUTERONS. K. Wagner (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 122-3(Mar. 1963). (In German)

For the formation of Bi^{206} from lead with deuterons at 13.5 Mev, an average value of 30 mC/ma hr was found. The activity measurement was followed with a gamma ionization chamber. As the gamma constant, a value of 18.7 r/hr was calculated. (tr-auth)

24431 ON PROBLEMS IN THE MATHEMATICAL STATISTICS INVOLVED IN THE DETERMINATION OF THE TOTAL EFFECTIVE CROSS SECTION FOR THERMAL NEUTRONS. Lénárd Pál and Éva Kisdiné Koszó. Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen., 11: 3-19(1963). (In Hungarian)

A consistent method of mathematical statistics is proposed for the evaluation of measured data. The variance of the optimum cross section estimation is determined. and calculations are made to find the neutron intensity minimizing this variance for a chosen channel if a time analyzer subject to saturation effect is used. (auth)

24432 GIANT RESONANCES IN PHOTONUCLEAR REACTIONS. E. Boeker (Vrije Universiteit, Amsterdam). Ned. Tijdschr. Natuurk., 28: 81-115(Apr. 1962). (In Dutch)

The characteristics of giant resonances that can be experimentally measured or theoretically explained are first summarized. A number of experimental methods and the analysis of the results obtained are then described. Bremsstrahlung, monoenergetic gamma radiation, and the (p,γ) reaction (considered as the inverse of the (γ,p) reaction) are the photonuclear reactions studied. Theoretical considerations are then discussed. Formulas for the reaction cross sections and the integrated cross sections are given. Two collective models, the independent-particle model, and the configuration mixing model (nuclear models that can be used to describe the phenomena found) are discussed. In conclusion, the models are brought under a common denominator. (J.S.R.)

24433 ATOMIC MASS OF NUCLIDES. A. H. Wapstra (Instituut voor Kernfysisch Onderzoek, Amsterdam). Ned. Tijdschr. Natuurk., 28: 149-64(June 1962). (In Dutch)

Measurement of the atomic mass of nuclides using mass spectrometers and nuclear reactions and decays is discussed. Utilization of the least squares method for analysis of mass spectrometric data is shown. The results obtained with the two methods are compared. Use of metastable isotopes for determination of the binding energy is also considered. (J.S.R.)

24434 THE UPPER SURFACE OF ATOMIC NUCLEI. D. Wierts and R. van Wageningen (Rijksuniversiteit, Groningen, Netherlands). Ned. Tijdschr. Natuurk., 28: 193-222(July 1962). (In Dutch)

The data on proton distribution within the nucleus that can be obtained from elastic electron scattering are indicated. The real and imaginary parts of optical potentials are discussed. The neutron distribution is probably related to the proton distribution. The mass distribution within the nucleus is theoretically considered. Experiments that indicate the presence of α structures at the nuclear upper surface are discussed. Alpha emission from heavy nuclei after bombardment with fast protons, α decay, and the observations of μ^- and K^- mesons coming to rest in nuclear emulsions are briefly reviewed. (J.S.R.)

24435 THE MAGNETIC MOMENTS OF EXCITED STATES OF NUCLEI. [PART] I. E. Bodenstedt (Universitat, Hamburg). Ned. Tijdschr. Natuurk., 28: 225-52(Aug. 1962). (In Dutch)

The results obtained up to the present on the experimental determination of the magnetic moment of excited nuclear states are summarized, and a critical evaluation is made of the sources of systematic error in these experimental methods. (J.S.R.)

24436 THE MAGNETIC MOMENTS OF EXCITED STATES OF NUCLEI. [PART] II. E. Bodenstedt (Universität, Hamburg). Ned. Tijdschr. Natuurk., 28: 269-92(Sept. 1962). (In Dutch)

In a continuation and conclusion of the experimental data presented in the first part, theoretical interpretations of the magnetic moments in the ground state and excited states are given using pertinent nuclear models. (J.S.R.)

24437 RESEARCH OF RADIOISOTOPE PRODUCTION WITH FAST NEUTRONS. IV. INVESTIGATION OF (n,p) AND (n,α) REACTIONS ON ^{35}Cl. Eiji Shikata (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 269-72(Apr. 1963). (In English)

(n,p) and (n,α) reactions on Cl^{35} were investigated from the viewpoint of S^{35} production. Potassium chloride was irradiated in various experimental holes of JRR-1 reactor. The activated S^{35} and P^{32} were separated and measured. Cross sections of both reactions for thermal and fission neutron flux were measured. Energy dependencies of the reactions for reactor neutrons and the methods of reducing the amount of P^{32} formed during irradiation were investigated. (auth)

24438 ZERO-POINT VIBRATIONS AND THE NUCLEAR SURFACE. G. E. Brown (NORDITA, Copenhagen) and Gerhard Jacob. Nucl. Phys., 42: 177-82(Apr. 1963). (In English)

The influence of zero-point vibrations on the ground state of spherical nuclei is calculated using the particle-hole formalism to describe the vibrations. With wave functions obtained from a Woods-Saxon potential, the influence of the first 3^-, T = 0 vibration on the radius and the surface thickness of Ca^{40} is estimated and the results are discussed. (auth)

24439 THE REACTION $Ca^{40}(\alpha,p)Sc^{43}$ WITH α-PARTICLES OF MAXIMUM ENERGY 20 Mev. N. O. Lassen and Clive Larsen (Univ. of Copenhagen). Nucl. Phys., 42: 183-96(Apr. 1963). (In English)

A calcium target was bombarded with α particles of energy 20 Mev and less. The protons emitted in various directions were recorded by means of a gridded ionization

chamber. When studying the upper end of the proton energy spectrum, levels in Sc^{43} were observed. Angular distributions were measured for several proton groups. The angular distribution for the protons corresponding to the ground state transition was compared with Butler's stripping theory; compound nuclear processes are presumably responsible for part of the cross section, but direct interactions play a major role. The main proton spectrum was found to consist of two groups, one corresponding to the protons emitted from the compound nucleus, the other to protons emitted from daughters of the compound nucleus. Both groups are nearly isotropic. Values for the nuclear temperature were obtained. (auth)

24440 EXCITATION OF COLLECTIVE OCTUPOLE STATES IN THE Pd–Sm REGION. O. Hansen and O. Nathan (Univ. of Copenhagen). Nucl. Phys., 42: 197-220(Apr. 1963). (In English)

Gamma ray transitions following inelastic scattering of 14–20 Mev α particles were observed from 30 even nuclei in the range $106 \leq A \leq 154$. The angular correlations between back-scattered α particles and de-excitation γ rays were measured in a number of cases. In addition to 2^+ and 4^+ collective quadrupole states collective 3^- states were systematically excited at somewhat higher excitation energies. For the strongest octupole excitations the reduced electromagnetic transition probabilities B(E3) were derived from yield measurements at low bombarding energies. The B(E3) values were found to be higher than the single-particle estimate by factors ranging from ≈15 to ≈100. The energy systematics of the octupole vibrations are discussed qualitatively in terms of the shell model with residual interactions. (auth)

24441 PAIRING MODEL FOR Pr-ISOTOPES. M. K. Pal (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and Dipti Mitra. Nucl. Phys., 42: 221-8(Apr. 1963). (In English)

The interaction between neutrons and protons filling different major shells is treated as a perturbation within the framework of the pairing force model. The lowest order effect is to keep the pairing model equations unchanged; only the single nucleon energies to be used therein are modified by an amount dependent on the number of the opposite kind of nucleons and the zero-rank component of the n-p potential. This effect produces the observed ground-state spins of $Pr^{141,143,145}$. The quasi-neutron-quasi-proton interaction, which contains the effect from the higher multipole components of the n-p potential, must be diagonalized to attempt a detailed fit to the spectra. This is particularly true for the odd nuclei $Pr^{142,144}$. There are two competing configurations for the ground state of Pr^{144}. (auth)

24442 THE CAPTURE OF K^- MESONS BY COMPLEX NUCLEI. G. N. Fowler and A. D. Crossland (Univ. of Bristol, Eng.). Nucl. Phys., 42: 229-34(Apr. 1963). (In English)

The effect on the two-nucleon capture process of nuclear and K^- meson orbit distortion brought about by the residual Coulomb interaction is studied. It is suggested that a collective type of capture process by the distorted nucleus could exist that gives reasonable agreement with emulsion experiments without the assumption of surface α-particle clusters. (auth)

24443 PHOTOPRODUCTION OF CHARGED PIONS FROM NUCLEI. [PART] II. V. Devanathan (Univ. of Madras) and G. Ramachandran. Nucl. Phys., 42: 254-63 (Apr. 1963). (In English)

The general expression for the cross section of the photoproduction of charged pions from nuclei is obtained in a simplified form by performing explicitly the sum over-all magnetic quantum numbers. The squares of the matrix elements are evaluated between the various single particle states of the shell model and they are tabulated. The calculation can now be made for any realistic case by using the concept of fractional parentage coefficient. (auth)

24444 NEUTRON EVAPORATION SPECTRA. C. H. Holbrow and H. H. Barschall (Univ. of Wisconsin, Madison). Nucl. Phys., 42: 264-79(Apr. 1963). (In English)

Thin targets of Ni, Rh, Ta, and Au were bombarded with protons of energies between 6 and 12 Mev. Neutrons emitted at angles up to 140° were observed. The neutron spectra were studied by time-of-flight spectroscopy. Except for Ni, continuous spectra resulted that had a Maxwellian energy distribution. The nuclear temperature showed, however, an anomalous increase with bombarding energy. Results consistent with the statistical theory could be obtained in the case of Rh by taking into account the energy dependence of the inverse reaction cross section. (auth)

24445 ON EXPERIMENTAL PROOF OF GELL-MANN THEORY OF β DECAY. THE β-α ANGULAR CORRELATION IN DECAY OF Li^8. W. Gruhle (Universität, Cologne), K. H. Lauterjung, B. Schimmer, and U. Schmidt-Rohr. Nucl. Phys., 42: 321-9(Apr. 1963). (In German)

The β-α angular correlation of the decay of Li^8 was determined by the simultaneous measurement of the α-β-coincidence rate at the angles 0°, 90°, 180°, and 270°. The average β-energy was 7.5 Mev. For the coefficients of the expected angular distribution $W(\vartheta) = 1 + A \cos \vartheta + B \cos^2 \vartheta$, $A = (-0.0083 \pm 0.0011)\ W_\beta$; $B = (+0.0037 \pm 0.0010)\ W_\beta$. These values are within the range predicted by the constant vector current theory. (auth)

24446 NUCLEON CORRELATIONS AND NUCLEAR LEVEL DENSITIES. D. W. Lang (Australian National Univ., Canberra and Barton Research Foundation, Swarthmore, Penna.). Nucl. Phys., 42: 353-66(Apr. 1963). (In English)

The high energy behavior of two nuclear models with pairing correlations is studied. It is found that level densities very closely resemble the Fermi gas forms at all energies above the neutron binding energy. For a model with a constant pairing energy between particles in doubly occupied pair states, the moment of inertia is lower than the rigid body value up to energies considerably higher than the neutron binding energy. In the second model, which is an analogue of the superconducting state of a metal, the moment of inertia reaches the limiting value below the neutron binding energy. It is suggested that for the latter model the Gorter-Casimir description of a superconductor gives a sufficient approximation to the level density. (auth)

24447 THE $^{23}Na(p,\gamma)^{24}Mg$ REACTION. [PART] II. P. W. M. Glaudemans and P. M. Endt (Rijksuniversiteit, Utrecht). Nucl. Phys., 42: 367-82(Apr. 1963). (In English)

Gamma-ray angular distributions and γ-γ angular correlations were measured at six $Na^{23}(p,\gamma)Mg^{24}$ resonances in the $E_p = 300-800$ kev region. Analysis of these data with an electronic computer yields spin and parity assignments: $J^\pi = 2^{(+)}$, $1^{(+)}$, 2^-, 3^+, $3^{(+)}$, and 2^+ to the resonances at $E_p = 308$, 511, 591, 676, 738, and 743 kev, respectively. The even parities in brackets are regarded as very probable. In each of these cases odd parity would imply the existence of an M2 transition with a strength of at least 0.5 Weisskopf

units. The same measurements give $J^{\pi} = 2^+$ for the Mg^{24} level at $E_x = 7.35$ Mev. Single spectra and γ-γ coincidence spectra measured at the weak $E_p = 251$ and 374 kev resonances yield the resonance branching ratios. (auth)

24448 DOUBLE COULOMB EXCITATION IN EVEN NUCLEI. A. C. Douglas (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Phys., 42: 428-40(Apr. 1963). (In English)

Calculations on double Coulomb excitation in even nuclei are reported. The semi-classical approximation is applied to second order perturbation theory. Electric quadrupole excitations of the form 0^+ (E2) 2^+ (E2) J^+, J = 0, 2, 4 are treated. It is assumed that only one intermediate state is important. (auth)

24449 QUASI-ELASTIC PROTON-ALPHA COLLISIONS IN CARBON. A. N. James (Univ. of Liverpool) and H. G. Pugh. Nucl. Phys., 42: 441-53(Apr. 1963). (In English)

The possibility of quasi-elastic p-α collisions in carbon nuclei was investigated experimentally by looking for correlated proton-alpha coincidences when C^{12} is bombarded by 150 Mev protons. A peak was found in the angular correlation centered about the kinematic angle for free p-α collisions and with a width, which when interpreted as arising from the α-cluster momentum before impact, gives momenta of about the same size as are observed in high-energy (p,2p) reactions. Under the circumstances of the experiment the probability of finding an α-cluster in the C^{12} nucleus was found to be 0.30 using a plane wave impulse approximation to integrate over the angular correlation. This figure is considered to be large since no allowance was made for the strong nuclear absorption effects expected. The detailed results pose certain problems for the α-cluster model of the C^{12} ground state. (auth)

24450 CONFIGURATION MIXING IN MASS 14 NUCLEI. M. A. Nagarajan (Case Inst. of Tech., Cleveland). Nucl. Phys., 42: 454-61(Apr. 1963). (In English)

The ground state configuration of C^{14} and N^{14} were determined using a zero-range force. Two models were used, one with O^{16} as the core and the other with C^{12} as the core. For the sake of simplicity, C^{12} is treated as a closed shell of $1p_{\frac{3}{2}}$ nucleons, and $1d^2_{\frac{5}{2}}$ and $2s^2_{\frac{1}{2}}$ configurations are mixed into the ground states of C^{14} and N^{14} with a spin-dependent zero-range potential. It is suggested that a realistic model would be one wherein an intermediate coupling configuration mixing calculation is made. This is necessary in order to explain the stripping and pick-up data on mass 14 nuclei. (auth)

24451 EXCITED LEVELS OF F^{19} STUDIED BY THE REACTION $O^{18}(p,\alpha_0)N^{15}$ AT 2.2 TO 6 Mev. S. Gorodetzky, M. Port, J. Graff, and J. M. Thirion (Institut de Recherches Nucléaires, Strasbourg). Nucl. Phys., 42: 462-8(Apr. 1963). (In French)

Excited levels of F^{19} were studied by the reaction $O^{18}(p,\alpha_0)N^{15}$ using O^{18} enriched self-supporting targets of Al_2O_3. In the whole energy range from 2.2 to 6.08 Mev the proton energy was determined with an accuracy of 0.25%. For alpha particle detection, solid state detectors were fixed at several angles. Two simultaneously obtained excitation curves at $\theta_{lab} = 165$ and 90° are presented. 73 resonances were observed and tabulated; 43 of them are new. The other resonances were found to be in good agreement with those previously observed in this energy range. (auth)

24452 LEVELS IN U^{232} EXCITED IN THE β-DECAY OF Pa^{232}. S. Bjoernholm (Univ. of California, Berkeley), F. Boehm, A. B. Knutsen, and O. B. Nielsen. Nucl. Phys., 42: 469-89(Apr. 1963). (In English)

The 1.34d Pa^{232} isotope was produced by neutron irradiation of Pa^{231} and the decay studied with a curved crystal spectrometer, a six-gap β-spectrometer, and scintillation spectrometers. Extensive coincidence measurements were performed. The Q value for β-decay of Pa^{232} is found to be 1345 ± 20 kev. The measurements permit unambiguous establishment of a decay scheme with 13 levels belonging to five rotational bands, built on the following band heads: the $(K,I,\pi) = (0,0^+)$ ground state, a $(0,1^-)$ level at 564 kev, a $(0,0^+)$ level at 693 kev, a $(2,2^+)$ level at 868 kev, and a state at 1018 kev with the assignment $(1,2^-)$ or $(2,2^-)$. There is evidence for considerable mixing of the two negative parity bands. The $(2,2^+)$ band, de-exciting by E2 transitions to the ground state band, also decays by E2 transitions to the $(0,0^+)$ band at 693 kev. The reduced transition probabilities of these latter E2 transitions are 16 times higher than of those to the ground state band, in contrast to what is expected from a simple description of the states in terms of collective quadrupole vibrations built on the ground state configuration. (auth)

24453 THE EFFECT OF SPECTATOR EXCHANGE TERMS IN He^4–He^3 SCATTERING. E. J. Squires (Univ. of California, Berkeley), A. E. Forest, and P. E. Hodgson. Nucl. Phys., 42: 490-7(Apr. 1963). (In English)

Exchange effects are included in a calculation of He^3–He^4 scattering and shown to improve considerably agreement with experiment, compared to the conventional optical model calculations. (auth)

24454 EXACT CALCULATION OF INELASTIC ELECTRON SCATTERING FOR MONOPOLE EXCITATION. Kurt Alder and Thomas H. Schucan (Univ. of Basel). Nucl. Phys., 42: 498-510(Apr. 1963). (In English)

An exact calculation of the cross section for inelastic scattering of relativistic electrons by nuclei was carried out for a special nuclear model. The nucleus was taken as an oscillating spherical drop of homogeneous charge density. The monopole excitation was computed for different nuclei and electron energies. The cross sections are compared with the corresponding Born approximation values. (auth)

24455 DIRECT INELASTIC SCATTERING OF NUCLEONS. M. El Nadi, H. Fahmy, and L. Abou-Hadid (Atomic Energy Establishment, Cairo). Nucl. Phys., 42: 511-20(Apr. 1963). (In English)

The forward and backward peakings observed in the angular distributions in nucleon collisions, are interpreted theoretically as forward knock on and heavy particle stripping, processes. Some experimental data on $C^{13}(p,n)N^{13}$ at varying proton energies were chosen and satisfactory fits were obtained. (auth)

24456 THE $B^{10}(p,n)C^{10}$ EXCITATION FUNCTION FROM THRESHOLD TO 10.6 Mev. L. G. Earwaker, J. G. Jenkin, and E. W. Titterton (Australian National Univ., Canberra). Nucl. Phys., 42: 521-8(Apr. 1963). (In English)

The excitation function for total neutron emission from the $B^{10}(p,n)C^{10}$ reaction was measured by an activation technique from threshold to $E_p = 10.6$ Mev. The absolute value of the cross section was determined as $\sigma = 2.0 \pm 0.2$ mb at $E_p = 8.50$ Mev. The excitation function reveals broad levels of C^{11} at 14.08 ± 0.02, 14.78 ± 0.04, 15.36 ± 0.05, and 15.61 ± 0.05 Mev. A sharp rise of cross section at $E_p = 8.55$ Mev occurs when transitions to the first excited state of C^{10} become possible. This cross section discontinuity enables the energy of the first excited state of C^{10} to be determined as 3.38 ± 0.03 Mev. (auth)

24457 A FERMI-THOMAS TYPE K-MATRIX METHOD FOR NUCLEI. Kailash Kumar, K. J. Le Couteur, and

M. K. Roy (Australian National Univ., Canberra). Nucl. Phys., 42: 529-50(Apr. 1963). (In English)

A generalised Fermi-Thomas method, in which K-matrices are used to obtain the potential energy, is used to calculate the energies and density distributions of nuclei for all mass values. It is shown that satisfactory agreement with the known empirical values, neglecting small shell effects, can be obtained but the corresponding K-matrices will differ from those given by Brueckner, Gammel and Weitzner. This method elucidates the manner in which the K-matrix affects the nuclear properties. (auth)

24458 THE DECAY OF $^{176}_{73}$Ta. H. Verheul, H. M. W. Booy, J. G. R. Okel, and J. Blok (Vrije Universiteit, Amsterdam). Nucl. Phys., 42: 551-62(Apr. 1963). (In English)

Measurements were performed on the direct gamma spectrum and the spectra of the gamma radiations coincident with conversion electrons emitted by Ta^{176}. Combining these results with the data given by Harmatz, it was possible to set up a level scheme in which nearly all the transitions found by the experiments could be placed. This level scheme was compared with those of neighboring nuclei and with the results of computations starting from some models for collective motions in nuclei. (auth)

24459 TABLES OF WHITTAKER FUNCTIONS AND THEIR LOGARITHMIC DERIVATIVES. D. F. Hebbard and B. A. Robson (Australian National Univ., Canberra). Nucl. Phys., 42: 563-81(Apr. 1963). (In English)

Tables of the logarithm (base 10) of the Whittaker function $W_{\eta,l}(\rho)$ are given for ρ = 0.1 (0.1) 3.0 (0.5) 8.0 (1.0) 18.0, η = 0.0 (0.1) 0.4 (0.2) 1.0 (0.25) 2.0 (0.5) 10.0 and l = 0 (1) 2. The tabulated values are accurate to better than 0.1%. Tables of the negative logarithmic derivative are also presented for ρ = 0.1 (0.1) 0.4 (0.2) 1.0 (0.5) 2.0 (1.0) 8.0, η = 0.0 (0.2) 1.0 (0.5) 2.0 (1.0) 10.0 and l = 0 (1) 2. The tabulated values are accurate to better than 0.5%. Over most of the table areas, linear interpolation in ρ or η and bivariate linear interpolation for ρ and η yields better than 1% accuracy. (auth)

24460 THE DECAY OF 293 MIN Tc^{94}. J. M. Matuszek, Jr. and T. T. Sugihara (Clark Univ., Worcester, Mass.). Nucl. Phys., 42: 582-91(Apr. 1963). (In English)

The 293 min Tc^{94} activity was produced by the reactions $Nb^{93}(\alpha, 3n)$ and $Mo^{94}(d, 2n)$. It decays chiefly by electron capture to Mo^{94} levels at 2425 ± 16 and 1579 ± 7 kev. Weak positon branches to both levels are also observed. Gamma rays (energies in kev) of 846 ± 14(72%), 705 ± 5(100%) and 874 ± 5(100%) are present. The beta transition to the 2425 level is followed by a 3γ cascade without crossover transitions. The previously known 52 min Tc^{94} activity is assigned to Tc^{94m}. The x-ray intensity of 52 min half-life is greater than that expected from its decay to Mo^{94}. The excess is attributed to a highly converted isomeric transition 52 min → 293 min. A spin of 5^+ is suggested for Tc^{94}. A solvent-extraction procedure for the separation of technetium is described. (auth)

24461 NUMERICAL METHODS IN THE DISTORTED WAVE THEORY OF HEAVY PARTICLE STRIPPING. D. Robson (Univ. of Melbourne). Nucl. Phys., 42: 592-601(Apr. 1963). (In English)

An investigation of some possible methods of calculating the heavy particle stripping amplitude in the distorted wave approximation is carried out. The validity of the zero-range approximation analogous to that used in ordinary stripping is examined, and results indicate that its range of validity is very restricted. A less approximate method, involving a finite-range interaction and harmonic oscillator functions, yields a calculable result. Numerical calculations are presented for the reaction $F^{19}(d, p)F^{20}$ and the various approximations compared. A comparison of the finite-range calculation with experiment indicates the need for a two-mode stripping theory for this reaction. (auth)

24462 MEAN LIFETIME OF THE FIRST EXCITED STATE OF Na^{23}. C. P. Swann (Franklin Inst., Swarthmore, Penna.). Nucl. Phys., 42: 602-7(Apr. 1963). (In English)

The mean lifetime of the first excited state of Na^{23} was measured by nuclear resonant scattering. Ne^{23} produced by the $Ne^{22}(d, p)$ reaction served as the source of exciting radiation. Assuming the spin of this state to be $^5/_2$, the mean life obtained is $(1.3 \pm 0.3) \times 10^{-12}$ sec. (auth)

24463 EXCITATION OF THE GROUND AND FIRST EXCITED STATES IN THE $Li^6(d, n)Be^7$ REACTION. L. Cranberg (Los Alamos Scientific Lab., N. Mex.), A. Jacquot, and H. Liskien. Nucl. Phys., 42: 608-14(Apr. 1963). (In English)

Results are reported on the angular distributions of neutrons corresponding to the ground state and first excited state in the reaction $Li^6(d, n)Be^7$ for deuteron energies of 2, 2.5, and 3 Mev. Comparisons are made of the total cross sections with results of a previous paper on $Li^6(d, p)Li^7$ for the corresponding states to test charge symmetry in nuclear reactions. This comparison shows agreement in the ratio of the yields to the ground and first excited states within the experimental accuracy. Comparison is also made of the differential cross sections with a DWBA calculation. The agreement with the observed results, although consistent with $\Delta l = 1$, is poor in the back direction. Some evidence is presented that suggests the importance of compound nucleus effects in the $Li^6(d, n)$ reaction. (auth)

24464 QUASI-DEUTERON PRODUCTION BY γ-RAYS IN ^{4}He. Arne Reitan (NORDITA, Copenhagen). Nucl. Phys., 42: 615-19(Apr. 1963). (In English)

The total cross section for direct absorption of γ rays by neutron-proton pairs is evaluated for helium on the assumption of shell-model initial-state wave functions. Electric dipole and quadrupole as well as magnetic dipole transitions are taken into account. The results are compared with the corresponding experimental cross section. (auth)

24465 SYSTEMATICS OF E2-M1 MIXING RATIOS OF $2'^+ \rightarrow 2^+$ TRANSITIONS IN EVEN NUCLEI. V. R. Potnis and G. N. Rao (Muslim Univ., Aligarh, India). Nucl. Phys., 42: 620-4(Apr. 1963). (In English)

Systematic variation of the reduced mixing ratio $(\delta/E_\gamma)^2$ of the $2'^+ \rightarrow 2^+$ mixed gamma ray transition as a function of neutron number in even nuclei is investigated. It is seen that the reduced mixing ratio approach the single particle estimate near the neutron magic numbers. 27 references. (auth)

24466 QUASI-FREE PROTON-PROTON SCATTERING IN Li^6 AND Li^7. A. Johansson and Y. Sakamoto (Uppsala Univ.). Nucl. Phys., 42: 625-37(Apr. 1963). (In English)

Angular correlation distributions for quasi-free proton-proton scattering in Li^6 and Li^7 were calculated and compared with experiment. The single particle model of the nucleus was used and the wave functions were adjusted to give electron form factors in agreement with Stanford scattering results. It is found that the best agreement with measured (p, 2p) results is obtained when the p-state protons are moving in a potential of larger extension than that for the s-state protons. Configuration mixing or a different model such as the cluster model would have to be invoked in order to reproduce the small angular distance between

the maxima of the Li^6 p-state distribution found experimentally. (auth)

24467 THE DECAY OF THE 1.14 MIN ISOMER OF Pa^{234} (UX_2). S. Bjoernholm and O. B. Nielsen (Universitet, Copenhagen). Nucl. Phys., 42: 642-59(Apr. 1963). (In English)

Sources of 24-d Th^{234}(UX_1) in equilibrium with its daughters, 1.14 min Pa^{234}(UX_2) and 6.75 h Pa^{234}(UZ) were studied with a six-gap β-spectrometer, scintillation spectrometers and with e-γ and β-γ coincidence techniques. Quantitative chemical separation of the three nuclides was performed and the individual γ-spectra and disintegration rates were measured. The short lived Pa^{234} isomer was found to populate three intrinsically excited states in U^{234}, a state with (K, I, π) = (0, 1^-) at (790 ± 5) kev, a (0, 0^+) state at 811 kev and another (0, 0^+) state at 1045 kev. Detailed results on β-, γ- and electric monopole transitions are presented and discussed. By applying three independent methods the relative disintegration rates of UX_2 and UZ were found to be 100 to 0.13 ± 0.03. A 70-73 kev isomeric transition of corresponding intensity was found in the conversion line spectrum. The possible assignments of the Pa^{234} levels are discussed. (auth)

24468 ALPHA-PARTICLE STRIPPING REACTIONS. E. V. Inopin and Mohamed Abd El-Moaty (Atomic Energy Establishment, Cairo). Nucl. Phys., 42: 660-5(Apr. 1963). (In English)

The cross-section for stripping of α-particles from bombarding nuclei, considered according to the α-particle model, was calculated. The target nucleus is considered to be a black nucleus. The calculations were carried out with correction for the finite magnitude of the target nucleus and taking the Coulomb repulsion into account. (auth)

24469 RELATIONS BETWEEN INTRINSIC PARITIES AND SPINS IN COLLISION AND DECAY PROCESSES. E. V. Inopin (Atomic Energy Establishment, Cairo). Nucl. Phys., 42: 666-8(Apr. 1963). (In English)

Symmetry properties of a process of collision in which the momenta of initial and final particles are collinear are considered. This leads to the selection rule formerly obtained by Litherland. The possibility of generalization of this rule is discussed. (auth)

24470 CAPTURE OF PROTONS BY B^{11} IN THE GIANT RESONANCE REGION. J. A. Becker and J. D. Fox (Florida State Univ., Tallahassee). Nucl. Phys., 42: 669-75(Apr. 1963). (In English)

The yield of γ rays resulting from proton capture by B^{11} leading to the ground state (γ_0) and first excited state (γ_1) of C^{12} was studied for proton energies from 6 to 13.2 Mev. The proton beam, held to less than 1 μamp to reduce pile-up, was focussed on the natural boron target and stopped in graphite 3 m from the target. The γ rays from the target were collimated to a beam 5 cm in diameter and entered a 12.7 cm diameter by 10.2 cm thick NaI(Tl) detector axially. Electronic pileup was reduced by using a biased preamplifier. All measurements were made with the detector at 90° to the incident beam and 30 cm from the target. The yield of γ_0 exhibits one strong maximum near 7.2 Mev (22.56 Mev in C^{12}) and decreases steadily at higher energies, except for a small anomaly at 10.4 Mev. The yield of γ_1 exhibits maxima at the incident proton energies 6.75, 8.4, 10.4, and 11.9 Mev. The experimental results are compared with the predicted T = 1 states of C^{12}. (auth)

24471 TOTAL RADIATION WIDTHS OF LEVELS IN ANTIMONY, MERCURY, RUTHENIUM AND IRIDIUM. H. H. Bolotin and R. E. Chrien (Brookhaven National Lab., Upton, N. Y.). Nucl. Phys., 42: 676-92(Apr. 1963). (In English) (BNL-6499)

An extension and elaboration of the "thin-thick" area method for the determination of the total widths of neutron resonances using transmission studies are described. Such determinations were made for a variety of levels in various isotopes of antimony, mercury, ruthenium, and iridium, using the Brookhaven fast chopper and 1024-channel time-of-flight analyser. Using a broad range of sample thicknesses, these data, in conjunction with the neutron widths obtained for these levels, resulted in a determination of the total radiation widths of a total of 18 resonances in these nuclides. Of particular importance were the total radiation widths obtained for the 6.23, 15.4, and 29.7 ev levels in Sb^{121} and the 43.3 and 71.8 ev levels in Hg^{201}. Previously reported experiments found these widths to differ by approximately a factor of 2 for levels in the same nuclide, contrary to what has been found in almost all medium and heavy nuclei investigated. The results presented here find these widths to be the same, within experimental error, for the levels in Sb^{121}, in disagreement with previous work, and confirm the wide fluctuations found for the resonances in Hg^{201}. A total of five radiation widths was obtained for levels in Ru, and in conjunction with data obtained using enriched isotopes, these results served to isotopically identify a level in Ru^{99} and one in Ru^{102}, which were not uniquely assigned on the basis of data from separated isotopes only. Total radiation widths were also obtained for three levels in Ir^{191} and one level in Ir^{193}. A discussion of these results is presented. (auth)

24472 THE 2691 kev LEVEL OF Te^{124}. C. Weitkamp (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Phys., 43: 57-9(May 1963). (In English)

Spin and parity of the 2691 kev level of Te^{124} are determined as 3^-. (auth)

24473 PROPOSALS FOR THE INVESTIGATION OF FAST NEUTRON CAPTURE BY THE LIGHTEST NUCLEI. K. Ilakovac and V. Knapp (Institut "Rudjer Boškovic," Zagreb). Nucl. Phys., 43: 69-75(May 1963). (In English)

In spite of the very small cross section, the fast neutron capture reaction for the lightest nuclei (protons and deuterons) appears to be a very powerful method to investigate details of the interactions and states involved. It is shown that, with available techniques, measurement of energy spectra of resulting nuclei can yield c.m. differential cross sections if mono-energetic neutrons are used. Neutron beams of broad energy spectrum can be applied to measure total cross sections in a wide range simultaneously. Effects of nucleon polarization could be investigated with beams of mono-energetic polarized neutrons. (auth)

24474 THE EXCITED STATES OF $^{134}_{56}Ba_{78}$. O. J. Segaert, J. L. Demuynck, L. V. Dorikens-Vanpraet, and M. Dorikens (Rijksuniversiteit, Ghent). Nucl. Phys., 43: 76-91(May 1963). (In English)

Conversion electron and gamma-ray spectra in Ba^{134} decay were investigated. The results together with the data obtained from γ-γ coincidences and sum-coincidence experiments confirmed the existence of 0.474(1.4), 0.564(10), 0.570(14), 0.604(100), 0.795(80), 0.801(11), 0.960(1.5), 1.040(1.6), 1.150(0.3), 1.168(1.5), 1.370(3.4), and 1.570(0.07) Mev gamma-rays and energy levels at 0.604(2^+), 1.168(2^+), 1.400(4^+), 1.564, 1.644, 1.76, and 1.972(4^+). Angular correlation work made possible the spin assignment of the levels at 1.564(1 or 2), 1.644(4), and 1.760(≧3)Mev. From the sum-coincidence studies it was concluded no levels appear at 1.36 and 1.84 Mev; levels higher than 1.97 Mev decaying

through double cascades are absent. No direct ground-state transitions of 1.77 (≤0.005) or 1.97 (< 0.003) Mev are observed. The Ba^{134} decay scheme is given; the existence of a 0.200-1.56 Mev cascade remains doubtful. Multipolarities of gamma-rays are assigned. (auth)

24475 STUDY OF THE REACTION $N^{14}(He^3,p)O^{16}$ AT 2.5 TO 5.5 Mev. S. Gorodetsky, G. Bassompierre, C. St-Pierre, A. Gallmann, and P. Wagner (Institut de Recherches Nucleaires, Strasbourg). Nucl. Phys., 43: 92-102(May 1963). (In French)

The excitation curves for the ground state proton group p_0 from the reaction $N^{14}(He^3,p)O^{16}$ were measured at 30°, 90°, and 150° between 2.5 and 5.5 Mev. These curves exhibit no resonance, thus suggesting a direct interaction mechanism. Angular distributions between 0° and 150° were determined at 2.5, 3.5, 4.5, and 5.5 Mev for the p_0 proton group and at 4.5 and 5.5 Mev for the $p_{1,2}$ and p_5 proton groups. The forward peak in the angular distributions of the p_0 proton group at 3.5, 4.5, and 5.5 Mev and of the p_5 proton group at 4.5 and 5.5 Mev was fitted by theoretical curves derived from Newns theory for double stripping processes. The differential cross-sections, in these cases, also rise in the backward direction. This increase may be due to "heavy particle" stripping or to the wave distortions produced by the Coulomb and nuclear forces. (auth)

24476 THE RESONANCES AT 483 AND 597 kev PROTON ENERGIES IN F^{19} + p REACTIONS. I. Berkes, I. Dézsi, Ilona Fodor, and L. Keszthelyi (Central Research Inst. of Physics, Budapest). Nucl. Phys., 43: 103-9(May 1963). (In English)

The resonances in the F^{19} + p reactions were investigated at 483 and 597 kev proton energies. With E_p = 483 kev resonance data for α-branching, proton capture and upper limits of the (p, p′) reaction were obtained. Combining these data with the results of angular distribution measurements of γ-rays, spin and parity 1^+ have been assigned to the 13.332 Mev level in Ne^{20} excited by 483 kev protons. From corresponding measurements with E_p = 597 kev, resonance data were obtained favoring the previously tentatively assumed 2^- assignment to the 13.440 Mev level in Ne^{20}. (auth)

24477 STUDY OF THE LONG RANGE NUCLEAR POTENTIAL BY SMALL ANGLE NEUTRON SCATTERING. Raymond Fox (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., 43: 110-23(May 1963). (In English)

The long range nuclear potential is studied by examining the shape of the central diffraction peak in small angle neutron scattering. The shape of the central diffraction peak is analysed by normalizing it at 0° and at the angle for which the scattering cross-section has decreased to one-fourth its 0° value. The shape of this normalized curve is found to be very sensitive to the weak long-range potential. It is also found to be relatively insensitive to the shape and magnitude of the core potential. Using this method of analysis, elastic scattering data at 96 Mev and 136 Mev for carbon indicate a potential tail longer than contained in the Saxon-Woods potential. (auth)

24478 GOOD RESOLUTION MEASUREMENT OF THE FISSION EXCITATION CURVE OF U^{238} BY FAST NEUTRONS AROUND 14 Mev. M. Mangialajo, F. Merzari, and P. G. Sona (CISE, Milan). Nucl. Phys., 43: 124-7(May 1963). (In English)

A measurement of the fission cross section for U^{238} by fast neutrons was made. The neutron energy was varied between 13.7 and 14.8 Mev with a neutron energy resolution of ≈100 kev. A semiconductor detector was used as fission fragment detector. The fission cross section was found to be 1.3 b and to be almost independent of the energy of the bombarding neutrons. (auth)

24479 EXACT CALCULATIONS ON THE INELASTIC SCATTERING OF HIGH ENERGY NUCLEONS FROM Li^6. Daphne F. Jackson and L. R. B. Elton (Battersea Coll. of Tech., London). Nucl. Phys., 43: 136-55(May 1963). (In English)

The inelastic scattering of high energy nucleons from the first excited state of Li^6 is considered in the impulse approximation. The distorted wave functions for the scattered nucleons are obtained exactly from an optical model calculation using a spin-independent optical potential. Detailed comparisons are made with previous work in which a WKB approximation for the distorted waves was used. It is concluded that the remaining discrepancies between theory and experiment for Li^6 at 40 Mev are due to the inadequacy of the nuclear wave functions. The comparison between exact and WKB calculations is also examined for a heavier nucleus. (auth)

24480 ENERGY LEVELS OF $f_{\frac{7}{2}}$ NUCLEI AND CONFIGURATION INTERACTION. T. Komoda (McGill Univ., Montreal). Nucl. Phys., 43: 156-69(May 1963). (In English)

Assuming different spin exchange types of the two body interaction, the energy levels of the $f_{\frac{7}{2}}$ nuclei with two or three nucleons outside the closed shell are calculated from the point of view of configuration mixing. Further, some properties relating to the ground state are calculated. The calculated values agree fairly well with the experimental values. It is found that the Coulomb interaction has no effect on the energy levels or on the properties of the ground state of the proton $f_{\frac{7}{2}}$ nuclei. (auth)

24481 THE (γ,α) REACTIONS ON MEDIUM WEIGHT NUCLEI. M. Kregar and B. Povh (Nuclear Institute "Jozef Stefan," Ljubljana, Yugoslavia). Nucl. Phys., 43: 170-76 (May 1963). (In English)

The alpha spectra at 90° from (γ,α) reactions on V, Ni, Cu, and Cd at 21 and 30 Mev betatron energies were measured. The measured shape of the spectrum for V^{51} agrees within the experimental error with the one calculated by the statistical model. The other spectra are very similar to the vanadium spectrum with the main difference due to the different Coulomb barriers. The relative yields of (γ,α) reactions at 90° on V, Ni, Fe, Cu, and Cd at both betatron energies were also measured. (auth)

24482 THE DECAY MODES OF THE $^4He_\Lambda$ HYPERNUCLEUS AND THE MEASUREMENTS OF THE $p_0^2/(p_0^2 + s_0^2)$ RATIO FOR $\Lambda_0 \rightarrow n + \pi^0$. M. M. Block (Northwestern Univ., Evanston, Ill.), R. Gessaroli, S. Ratti, L. Grimellini, T. Kikuchi, L. Lendinara, L. Monari, and E. Harth. Nuovo Cimento (10), 28: 299-308(Apr. 16, 1963). (In English)

The helium bubble chamber was exposed to a stopping K^- beam and 237 $_\Lambda He^4$ hypernuclei, produced in the reaction $K^- + He^4 \rightarrow \pi^- + {}_\Lambda He^4$, were found. The probability for p-wave emission in the decay $\Lambda^0 \rightarrow n + \pi^0$ was deduced to be $p_0^2/(p_0^2 + s_0^2) = 0.16 \pm 0.16$, from the ratio of the decay modes $_\Lambda He^4 \rightarrow$ all π^0 and $_\Lambda He^4 \rightarrow$ all π^-. This result is in good agreement with the prediction of the $\Delta I = \frac{1}{2}$ law. Stimulated decay mechanisms of the Λ^0, e.g., non-mesonic decays and $_\Lambda He^4 \rightarrow \pi^+ + n + H^3$, are discussed. (auth)

24483 DISINTEGRATION OF HYPERFRAGMENTS. M. H. Siddique (Rajshahi Univ., East Pakistan). Pakistan J. Sci. Ind. Res., 5: 229-31(Oct. 1962).

A search was made for hyperfragments produced by 500 Mev/c K^- mesons in nuclear emulsion. A large num-

ber of events was found. An analysis of five of them is reported. This includes one case of non-mesonic decay of a helium hyperfragment. The binding energy found in each case is in agreement with the value obtained at other laboratories. (auth)

24484 A NOTE ON EXCHANGE FORCES IN NUCLEI. S. M. Ayub. Pakistan J. Sci. Ind. Res., 5: 275-6(Oct. 1962).

The possibility of neutron-proton forces established by an exchange of an electron-neutrino pair is considered. This is rendered plausible by the fact that the meson (π) sometimes breaks directly into an electron, a neutrino, and a photon, without passing through the meson (μ) stage. This type of exchange coupled with the meson (π) exchange theory in suitable proportions could establish the observed neutron-proton forces. (C.E.S.)

24485 DESCRIPTION OF NUCLEI Z = 50 BY A MODEL OF QUASI PARTICLES IN INTERACTION. R. Arvieu (Laboratoire Joliot-Curie de Physique Nucleaire, Orsay, France), Elizabeth Baranger, M. Veneroni, M. Baranger, and V. Gillet. Phys. Letters, 4: 119-22 (Mar. 15, 1963). (In French)

A detailed numerical study is being made of nuclei having a complete shell. Results are presented for tin isotopes, calculated with three different sets of parameters (μ/fermi, V_0/Mev, $V_0\,\mu^2$, ω, ϵ 5/2, ϵ 7/2, ϵ 1/2, ϵ 3/2, and ϵ 11/2. The results obtained for the mass differences and for the positions of the first levels are shown graphically for both theoretical and experimental results. The effect of the choice of parameters on the agreement between theory and experiment is discussed. (J.S.R.)

24486 CYLINDRICAL BESSEL FUNCTION DEPENDENCE IN THE ANGULAR DISTRIBUTION OF THE $He^3(d,p)He^4$ STRIPPING REACTION AT 27 Mev. O. M. Bilaniuk and R. J. Slobodrian (Comision Nacional de Energia Atomica, Buenos Aires). Phys. Letters, 4: 209-11 (Apr. 15, 1963). (In English)

A He^3 gas target was bonbarded with a 27 Mev deuteron beam, and the angular distribution of protons from the reaction $He^3(d,p)He^4$ was recorded in the range 0 to 170° cm. From the four theoretical fits given, the cylindrical Bessel functions produce a remarkable fit to the data in the entire angular range. (C.E.S.)

24487 SPIN ASSIGNMENTS IN Mn^{55} VIA INELASTIC NEUTRON SCATTERING. R. C. Lamb and M. T. McEllistrem (Univ. of Kentucky, Lexington). Phys. Letters, 4: 211-12(Apr. 15, 1963). (In English)

Evidence is presented for a definite spin sequence for the first three excited levels of Mn^{55} and for a tentative assignment for the fourth. The basis for these assignments is a series of measurements of inelastic neutron scattering. (C.E.S.)

24488 THE EXCITED STATES OF Nb^{93}. C. A. Engelbrecht (Argonne National Lab., Ill.). Phys. Letters, 4: 213-15(Apr. 15, 1963). (In English)

Ratios of cross sections for the excitation of second and third, second and fourth, and third and fourth excited levels in niobium-93 are presented for inelastic neutron scattering. Assuming the spin values $^7/_2$, $^5/_2$, and either $^9/_2$ or $^{11}/_2$ for levels 2, 3, and 4, conclusions concerning the parity of these levels are discussed. (C.E.S.)

24489 EVIDENCE OF ALPHA STRUCTURES IN HEAVY NUCLEI. H. Gauvin, M. Lefort, and X. Tarrago (Laboratoire Joliot-Curie, Faculté des Sciences, Orsay, France). Phys. Letters, 4: 215-17(Apr. 15, 1963). (In French)

The excitation functions and alpha spectra for the reaction $Bi^{209}(p,\alpha)$ at proton energies of 60 to 600 Mev were analyzed. The results are shown to be compatible with a model in which α particles exist inside the nucleus and are ejected from the nucleus by the protons via a "knock-out" process. (T.F.H.)

24490 SATURATION EFFECTS OF ULTRASONICS ON NUCLEAR MAGNETISATION IN SOLIDS. P. Averbuch (Université, Grenoble, France) and W. G. Proctor. Phys. Letters, 4: 221-2(Apr. 15, 1963). (In English)

The master equation for the nuclear magnetization of atomic nuclei due to the sonic energy that the spin system has absorbed is derived for ultrasonic saturation effects. The ultrasonic transition probability between spin levels is calculated. (C.E.S.)

24491 NEUTRON-PROTON RESIDUAL INTERACTIONS IN THE $Y^{89}(d,p)Y^{90}$ REACTION. A. I. Hamburger and E. W. Hamburger (Universidade de São Paulo, Brazil). Phys. Letters, 4: 223-4(Apr. 15, 1963). (In English)

The $Y^{89}(d,p)Y^{90}$ reaction was studied for 15-Mev deuterons. Measurements of the energy splitting caused by the neutron-proton coupling in odd-odd Y^{90} are reported. Angular distributions for 27 levels of Y^{90} were obtained. (C.E.S.)

24492 THE CHARACTER OF THE COUPLING POTENTIAL IN DIRECT INTERACTIONS. A. P. Stamp (Nuclear Physics Lab., Oxford). Phys. Letters, 4: 230-2 (Apr. 15, 1963). (In English)

The inelastic scattering of tritons and He^3 particles by deformed nuclei is considered as a possible test to determine whether the coupling potential that excites collective states is real or complex. (C.E.S.)

24493 NUCLEAR CAPTURE OF NEGATIVE MUONS FROM NEON. G. Conforto, C. Rubbia, and E. Zavattini (CERN, Geneva). Phys. Letters, 4: 239-40(Apr. 15, 1963). (In English)

The meson(μ) nuclear capture probability of a neon mesicatom was determined by measuring the lifetime and the relative meson(μ)-decay electron yield for several neon concentrations. Since the capture probability of a μ in liquid hydrogen is very small, the change of the decay electron yield may be directly related to the product of the fraction of μ transfered to neon times the nuclear absorption probability of a neon mesication. To increase the transfer rate to neon mesicatoms the natural hydrogen was enriched with about 0.5% deuterium. Time distributions of the de-excitation mesic x rays and decay electron yields before and after two separate neon injections are shown. (C.E.S.)

24494 ON THE MULTI-NUCLEON CAPTURE OF K^- MESONS IN COMPLEX NUCLEI. Z. Fraenkel (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Letters, 4: 246-8(Apr. 15, 1963). (In English)

A previously suggested two-stage process $K^- + N \rightarrow Y^*$, $Y^* + N \rightarrow Y + N$ for the two-nucleon capture of K^- is investigated. The two-nucleon capture probability for K^- is calculated for complex nuclei. From the results obtained, the two-stage process cannot explain the experimentally observed fraction of two-nucleon capture without a further assumption of very high two-particle correlations, in which case the separation of the K^- capture process into two distinct stages seems questionable. (C.E.S.)

24495 CORE EXCITATIONS IN Cu^{63}. H. E. Gove (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Letters, 4: 249-51(Apr. 15, 1963). (In English)

Experimental results on Cu^{63} are compared with the predictions of three models that have been proposed to explain the properties of the low lying levels in odd-A nuclei that involve coupling between the odd particle and surface vibrations of the core. The results hold identically true for Cu^{65} also. (C.E.S.)

24496 $N^{14}(d,n)O^{15}$ REACTION. J. Csikai and G. Petoe (Inst. of Nuclear Research, Hungarian Academy of Sciences, Debrecen). Phys. Letters, 4: 252-3(Apr. 15, 1963). (In English)

The neutron yield curve for the reaction $N^{14}(d,n)O^{15}$ was investigsted in the deuteron energy region 0-700 kev by measuring the O^{15} residual beta activity. The total number of emerging neutrons per sec is plotted as a function of the bombarding deuteron energy. In the deuteron energy region ≤300 kev the majority of the emerging neutrons leave the O^{15} nucleus in the excited stated 5.193 and 5.248 Mev. (C.E.S.)

24497 A D.W.B.A. ANALYSIS OF THE REACTION $Si^{28}(n,p)Al^{28}$ WITH EXCHANGE INTERACTION. A. Agodi, R. Giordano, and G. Schiffrer (Università, Catania, Italy). Phys. Letters, 4: 253-4(Apr. 15, 1963). (In English)

A numerical mistake was pointed out for a previous distorted wave Born approximation of the reaction $Si^{28}(n,p)Al^{28}$ at 14 Mev neutron energy for zero range approximation for the (n-p) interaction (NSA 17: 9566). New data is also included for the reaction assuming an ordinary Yukaw potential and a Yukaw potential with Serber exchange for the (n-p) interaction. (C.E.S.)

24498 Li^6 AND Li^7 PRODUCTION IN O^{16} BY 156 Mev PROTONS. E. Gradsztajn, M. Epherre, and R. Bernas (Faculté des Sciences, Orsay, France). Phys. Letters, 4: 257-8(Apr. 15, 1963). (In English)

Results on both the Li^7/Li^6 ratio and the absolute cross section for the production of the isotopes in oxygen bombardment of 156-Mev protons are presented. Mass spectrometry and isotope dilution techniques were used. (C.E.S.)

24499 ON PROBABILITY DISTRIBUTIONS OF NUCLEAR CROSS SECTIONS. T. Ericson (CERN, Geneva). Phys. Letters, 4: 258-9(Apr. 15, 1963). (In English)

The nuclear cross section probability distributions in heavy nuclei are shown to be of simple form and to yield information on the reaction mechanisms and the structure of the scattering amplitude. The form of the probability distribution obtained provides a consistency check on the results obtained from cross section correlation functions. Scattering amplitudes are considered for an inelastic process in which all initial and final spins are zero. (C.E.S.)

24500 ANGULAR CORRELATIONS AND POLARISATION IN $(p,p'\gamma)$ REACTIONS. Ph. Loncke (Faculté des Sciences, Orsay, France). Phys. Letters, 4: 284-5(May 1, 1963). (In English)

Aspects of describing the $(p,p'\gamma)$ reaction by the impulse approximation that involves Wolfenstein's two-body transition matrix M and, through it, nucleon-nucleon phase parameters are examined. Particularly, derivation of coefficient combinations for M from the correlation between the angular distribution and polarization of emerging protons, and the angular distribution of photons emitted in the deexcitation of a given nucleus level, particularly the 15.1-Mev C^{12} level, is considered. (D.C.W.)

24501 THE He^5 STATES AT HIGH EXCITATION ENERGIES. R. E. Shamu, G. G. Ohlsen, and P. G. Young (Australian National Univ., Canberra). Phys. Letters, 4: 286-8 (May 1, 1963). (In English)

The total cross section of He was measured for neutron energies of 20 to 29 Mev to determine the effect on the cross section of the 16.70-Mev state of He^5 and of a proposed broad state at an excitation energy of about 20 Mev. Data for determining the n-He^4 phase shifts to permit calculation of the analyzing power of He for polarized neutrons was also obtained. The observed change caused in the cross section by the 16.7-Mev state is consistent with the parameters $J = 3/2$ and $\Gamma_d \approx \Gamma_n$ that were obtained from studies of the $T(d,n)He^4$ reaction. No anomaly corresponding to the 20-Mev excitation was observed. (auth)

24502 ON THE PHOTO-DISINTEGRATION OF Li^6. S. Costa (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin), S. Ferroni, V. Wataghin, and R. Malvano. Phys. Letters, 4: 308-10(May 1, 1963). (In English)

The cross section and neutron yield function for the $Li^6(\gamma,tn)$ reaction were measured. Broad resonances in the cross section at about 11.5 and 26 Mev were noted. Photodisintegration processes are discussed, and a model to explain the 26-Mev peak is proposed. In the model Li^6 would split virtually into an α particle, and a deuteron, all other intermediate state giving negligible contributions to the disintegration cross section. Interaction of the incident γ ray with the α particle would contribute most to the cross section in this region. (D.C.W.)

24503 PHOTOPROTONS EMITTED FROM LIGHT NUCLEI AND NUCLEAR SHELL STRUCTURE. Saburo Fujii (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 29: 374-82(Mar. 1963). (In English)

The differential cross sections of photoprotons emitted from light nuclei at the photon energies of 50 ~ 100 Mev are explained using the direct interaction model. Some features reflecting the nuclear shell structure are pointed out and their relation to the information obtained from (p,2p) is discussed. (auth)

24504 RESIDUAL INTERACTIONS IN NUCLEAR SHELL MODEL AND PAIRING ENERGIES. Kiyoshi Sasaki (Tokyo Metropolitan Univ.). Progr. Theoret. Phys. (Kyoto), 29: 383-96(Mar. 1963). (In English)

An effective residual interaction of the shell model is investigated by making use of the experimental values of the nucleon pairing energies. It is assumed that the effective interactions between paired like nucleons (n-n, p-p) in the same orbit are central forces and have the form $V_{ij} = [V_0 + V_1(\sigma_i \cdot \sigma_j)]\, f(r_{ij})$, and the Gaussian and Yukawa types are used for $f(r_{ij})$. The strength parameters V_0 and V_1 are determined from $P(j)_{exp}$ and $\Pi(j)_{exp}$ in the pure configurations. The results are $V_1/V_0 \sim 2$, then the effective residual interactions are near upon the Rosenfeld force. The effects of tensor force and configuration mixing on V_0 and V_1 obtained in the case of central force and pure configurations are investigated. The parameters to give nuclear binding energies are evaluated and these values are compared with those given by others. A discussion for the effective residual interactions thus obtained is made. (auth)

24505 PHASE TRANSITION AND LEVEL DENSITY OF ATOMIC NUCLEI. Mitsuo Sano and Shuichiro Yamasaki (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 29: 397-414(Mar. 1963). (In English)

The effect of the pairing interaction on nuclear spectrum is studied with the aid of a modern theory of superconductivity. A statistical dynamical approach to examine the gross behavior of the excited states is used. For the nuclei

of medium weight, a phase transition is predicted at the transition energy of some 5 to 10 Mev. The level density below this energy is greatly different from that expected on extrapolating it from higher energy side. It is discussed that the imaginary part of the optical potential can be much smaller than that obtained by the Fermi gas model. (auth)

24506 CRITICAL TEMPERATURE OF NUCLEAR MATTER. Masayuki Nagasaki (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 29: 415-21(Mar. 1963). (In English)

In order to get some insight into the characteristic behavior of nuclei in the high energy region, the concept of critical temperature of matter is used to investigate fully the particular case of nuclear matter of the α particle type, which is composed of equal even number of protons and neutrons, by applying De Boer's principle of corresponding states. The result is $T_c \simeq 3$ Mev. This method gives also the nucleon density and the nuclear pressure at the critical point, $1/15$ nucleons/y^3, and $1/80$ Mev/y^3, respectively. Discussions of these results are given. (auth)

24507 NEUTRON-PROTON INTERACTIONS IN Cl^{38} AND K^{40} BASED ON j-j COUPLING SHELL MODEL. Kiyoshi Sasaki (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 29: 461-2(Mar. 1963). (In English)

An analysis of the correlations between nucleons in (n-p) interactions in Cl^{38} and K^{40} was carried out in the j-j coupling shell model using experimental data on low-lying states in these nuclei. The three dimensional isotropic harmonic oscillator wave-function was used as a one-particle wave function. (C.E.S.)

24508 PRODUCING RADIOISOTOPES IN A REACTOR BY USING THRESHOLD, CONSECUTIVE AND SECONDARY NUCLEAR REACTIONS. V. I. Levin and V. V. Bochkarev. Tr. Tashkentsk. Konf. po Mirnomu Ispol'z. At. Energii, Akad. Nauk Uz. SSR, 2: 368-72(1960).

It is shown that certain radioisotopes that cannot be produced from the (n,γ) reaction can be produced on an industrial scale by using the (n,p), (n,α), and (n,2n) threshold neutron reactions and also by using certain secondary processes taking place in a reactor, in particular repeated (n,γ) reactions or reactions of the target isotopes with tritons formed, for example, in the $Li^6(n,\alpha)H^3$ reaction. Methods of obtaining the isotopes Co^{58}, As^{74}, Mn^{54}, Na^{24}, Zr^{89}, and Nb^{92} by using the threshold reactions: $Ni^{58}(n,p)Co^{58}$, $Se^{74}(n,p)As^{74}$, $Fe^{54}(n,p)Mn^{54}$, $Al^{27}(n,\alpha)Na^{24}$, $Mo^{92}(n,\alpha)Zr^{89}$, and $Mo^{92}(n,p)Nb^{92}$ are described. This method of producing radioisotopes is particularly valuable for use with reactors with high neutron beam intensities and with fast reactors. (Referativnyy zhurnal, Khimiya, No. 8, 1962)

24509 STUDY OF THE REACTION $Bi^{209}(n,\gamma)Bi^{210}$ WITH A GAMMA-GAMMA COINCIDENCE METHOD. L. Jarczyk, J. Lang, R. Mueller, and W. Woelfli (Eidgenossische Technische Hochschule, Zurich). Z. Angew. Math. Phys., 13: 117-32(1962). (In German)

For the reaction $Bi^{209}(n,\gamma)Bi^{210}$, the Q-value as determined from a suitable reaction chain exceeds that indicated by the γ line of maximum energy as measured with a magnetic pair spectrometer. Coincidence investigations were undertaken to search for γ-γ cascades; transitions for 117, 165, 275, 396, and 507 kev were detected in coincidence with the lines at 4 Mev. The intensities of the former lines were elucidated and are discussed. The most probable value for the neutron binding energy is thereby indicated to be 4.56 Mev. (auth)

24510 THE ANGULAR DISTRIBUTION IN THE REGION 30 TO 155° OF ELECTRONS SCATTERED ELASTICALLY BY GOLD VAPOR WITH ENERGIES BETWEEN 150 AND 1900 ev. E. Reichert (Johannes-Gutenberg-Universität, Mainz). Z. Physik, 173: 392-401(1963). (In German)

The angular distribution of electrons scattered elastically by gold atoms was investigated over the angular range from 30 to 155° and with electron energies between 150 and 1900 ev. The scattering curves obtained resemble closely the corresponding curves for mercury atoms. The theoretically expected energy dependence of the 90° scattering is in poor agreement only with the results obtained experimentally in this work. (auth)

24511 GAMMA RADIATION FROM INELASTIC SCATTERING OF 14-Mev NEUTRONS ON CALCIUM, OXYGEN, AND CARBON. Alfred Hofmann (Universität, Erlangen-Nuremberg). Z. Physik, 402-12(1963). (In German)

Calcium, oxygen, and carbon in various compounds were excited by inelastic scattering of 14-Mev neutrons, and the originating gamma spectra were measured with a NaI(Tl) scintillation spectrometer. The energy quantas found allowed the energy-level scheme of the bombarded nuclei to be arranged. For Ca^{40} a transition of the 8.4-Mev level and at least one level of the triplet at 5.3-Mev to the ground state, as well as a transition of the 4.48-Mev level to the 3.73-Mev level, were observed. Other processes in the well-known gamma decay of various other levels of Ca^{40}, O^{16}, and C^{12} were also found. (tr-auth)

24512 COLLECTIVE MOTIONS IN THE NUCLEAR SHELL MODEL. Boudewijn Johannes Verhaar. Thesis, Amsterdam, Universiteit Amsterdam, 1962. 169p.

The relation between more complicated versions of the shell and collective models are investigated by studying the collective motions occurring in a system of nucleons according to the shell model. A simple shell model in which the nucleons move independently in a harmonic oscillator potential is selected for study, and the wave functions are transformed into a representation that can be used to study collective properties. Collective translation, rotation, and vibration are the motions discussed. A classification of the eigenfunctions in the shell model by group theory provides a way for eliminating spurious states. The classification is extended to an anisotropic harmonic oscillator potential to aid the study of rotation and translation, and the classification also permits a study of the dependence of the shell model hamiltonian and its eigenfunctions on the collective variables. (D.C.W.)

24513 APPLICATIONS OF DIGITAL COMPUTER TECHNIQUES TO THEORETICAL INVESTIGATIONS AND TO THE ANALYSIS OF EXPERIMENTAL DATA IN NUCLEAR SPECTROSCOPY. Werner Schneider. Thesis, Uppsala, Uppsala Univ., 1963. 9p.

Digital computer techniques are applied to nuclear level splitting caused by static combined magnetic dipole and electric quadrupole interaction. The theory of perturbed angular correlations is reformulated for a numerical treatment and explicit results are computed for some important experimental cases. Digital computer techniques are also applied to the design of beta-ray spectrometer, and the automatic analysis of beta spectra is discussed as an example for the processing of experimental data. (C.E.S.)

24514 INVESTIGATIONS OF NUCLEAR STRUCTURE AND INTERACTION SYMMETRIES WITH HIGH ENERGY PROTONS. Gunnar Tibell. Thesis, Uppsala, Uppsala Univ., 1963. 10p.

The asymmetry and polarization in elastic and inelastic proton-nucleus scattering at 155–180 Mev are discussed.

The existence of virtual excited states in He^4 was investigated by inelastic scattering of 185 Mev protons. Investigations of quasi-free proton-proton scattering in Li^6, Li^7, and Ca^{40} are reported. A test of charge independence in meson (π)-nucleon interactions is also presented. (C.E.S.)

Particle Accelerators

Refer also to abstracts 23627, 23628, 23630, 23632, 23634, 23635, 23636, 23637, 23638, and 23708.

24515 (BNL-6974) SPACE HARMONIC ANALYSIS OF THE $\pi/2$ DEFLECTING MODE: THE MAXIMUM DEFLECTION. H. Hahn (Brookhaven National Lab., Upton, N. Y.). Apr. 16, 1963. Contract AT-30-2-GEN-16. 26p.

Space harmonic analysis for the maximum deflection in square-iris-loaded waveguides is demonstrated. Only the lowest passband of the hybrid electromagnetic mode that exhibits deflecting properties useful for an r-f particle separator is considered. The usual Fourier expansion of the expressions for the center and slot region fields is performed; determination of expansion coefficients is considered (values are given); expressions for the average power flux density, the average power flux density for unit equivalent field strength, and the total power for an equivalent field strength are derived; a relation for the deflection angle and particle momentum is given; and a deflection impedance is introduced. (D.C.W.)

24516 (CERN-63-2) ETUDE DE L'OPTIQUE DES TRAJECTOIRES DE SORTIE DES PARTICULES DANS UN ACCELERATEUR FFAG DU TYPE OHKAWA. (Study of the Optics of the Particle Orbits in FFAG Accelerators of the Ohkawa Type). B. V. Robouch (European Organization for Nuclear Research, Geneva). Jan. 21, 1963. 52p.

The problems of the interpretation of experiments made on a hypothetical accelerator of the Ohkawa type for 90-Mev electrons were studied in an attempt at clarification. The equations of motion are solved, and numerical results are presented for three trajectories. The trajectories studied are trajectories of the plane Z = 0, trajectories of the plane $\phi = k\pi/N$, and left trajectories. The effects of finite beam dimensions are also considered. (J.S.R.)

24517 (DESY-A-2.97) SOME TECHNICAL PROBLEMS OF RF ACCELERATION FOR PARTICLE ACCELERATORS ABOVE 10 Gev. G. Schaffer (Deutsches Elektronen-Synchrotron, Hamburg). Dec. 19, 1962. 21p.

Some aspects of r-f acceleration of particles to above 10 Bev are briefly discussed; and technical problems such as the generation of very high r-f power in the uhf range, design and fabrication of high Q accelerating units, and beam control and loading are examined. (D.C.W.)

24518 (DESY-A-2.98) PRELIMINARY DESIGN OF SPECIAL MAGNET PULSING EQUIPMENT FOR THE DESY ACCELERATOR. Martin M. Berndt (Deutsches Elektronen-Synchrotron, Hamburg). Feb. 12, 1963. 28p.

Design of the pulsing circuit, power supplies, magnet windings, transformers, tubes, and protective circuit to be used in the arrangement for moving the accelerated electron beam is discussed. Diagrams of the pulsers and the grid power supply are included. (D.C.W.)

24519 (IFA/A/28) ON THE EFFICIENCY OF SOME METHODS FOR INCREASING THE YIELD OF A BETATRON. C. C. Iliescu, S. Haltrich, and I. Leibovici (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1962. 19p.

The capture process in betatrons is briefly discussed, and methods for improving the output of betatrons are examined. Corrections to the field index distribution and the use of so-called contractors are considered, the former technique receiving most attention. Curves showing the efficiency of the methods are included. (D.C.W.)

24520 (LADC-5474) WAVEGUIDE TAPERS. Bernard Hayes (Los Alamos Scientific Lab., N. Mex.). [196?]. Contract [W-7405-eng-36]. 31p.

A mathematical investigation of waveguide tapered sections is undertaken. The nonlinear differential equation describing propagation through a taper is derived so that particular solutions of the differential equation may be applied to E-plane, H-plane, and compound tapered sections in rectangular waveguides as well as flared sections in cylindrical waveguides. Reflectionless tapers are obtained by properly apportioning the waveguide wall shape together with the length of taper section. Such a procedure is generally necessary; however, a notable exception is the constant impedance compound taper that has no critical length and for which the shape of one of the walls may be chosen arbitrarily. (auth)

24521 (LAL-1048) PROGRAMME DE CALCUL POUR LES TRANSPORTS DE FAISCEAUX. (Program of Calculation for Transport of Beams). R. Belbeoch (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de l'Accélerateur Lineaire). Jan. 1963. 10p.

The matrices used for the first-order calculation of optical systems for beam transport are given. The vectors characterizing the horizontal and vertical motions have (x, x', $\Delta p/p$, 1) and (y, y', $\Delta p/p$, 1) as components. The 4e component was introduced in order to utilize the matrical calculation when the transfer in a magnet is not calculated from a particular trajectory in this magnet (x = 0 and x' = 0 is no longer a solution of the equation of motion). (tr-auth)

24522 (MURA-666) RESONANT BEAM EXTRACTION IN FIXED FIELD ALTERNATING GRADIENT ACCELERATORS. Werner William Schoultz and C. L. Hammer (Iowa State Univ. of Science and Tech., Ames. Inst. for Atomic Research and Midwestern Universities Research Assn., Madison, Wis.). Jan. 2, 1963. Contract AT(11-1)-384. 35p.

The resonant beam extraction method proposed by C. L. Hammer and L. J. Laslett for constant gradient and alternating gradient accelerators was extended to fixed field alternating gradient accelerators. It is possible to find field perturbations that are effective in causing the radial betatron oscillations to grow exponentially at a particular azimuthal position, and which at the same time have an effect upon the equilibrium orbit which greatly enhances ease of extraction. Digital calculations verifying the analytical predictions are presented. It remains necessary, however, to choose field perturbations that do not introduce nonlinear effects having unfavorable extraction characteristics. (auth)

24523 (MURA-667) PERTURBATION THEORY FOR ACCELERATORS WITH A GENERAL MAGNETIC FIELD. [PART] II. George Parzen (Midwestern Universities Research Assn., Madison, Wis.). Mar. 4, 1963. Contract AT(11-1)-384. 13p.

The effects of a perturbing field on the linear properties of an accelerator with a general magnetic field are calculated. The perturbing magnetic field in the median plane is assumed to have only a vertical component and to contain no harmonics having the same periodicity as the un-

perturbed field. Results are found for the change in the equilibrium orbit and in the betatron oscillation frequencies caused by the perturbation. (auth)

24524 (NIRL/R/23) ELECTROSTATIC GENERATOR GROUP PROGRESS REPORT, 1962. (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Dec. 1962. 99p.

Design and development of an electrostatic generator facility for accelerating both negative and positive ions is described. The arrangement consists of a horizontal tandem accelerator and a vertical accelerator. The accelerators can be operated individually or as a compound machine. In the latter situation, negative ions may be injected into the vertical machine by a source at its top, accelerated through voltages of 8–10 mv, and deflected through 90° into the tandem machine to yield 20-Mev proton beams and 60- to 80-Mev oxygen and sulfur ions. The various components of the system are examined, and a small Van de Graaff (900 kv) and a larger accelerator (5 mv) used in development of the Oxford electrostatic generator are described. Results of tests performed with the two are also given. Ion source development and the beam optics of the facility receive particular attention. (D.C.W.)

24525 (TID-18636) REPORT OF THE PANEL ON HIGH ENERGY ACCELERATOR PHYSICS OF THE GENERAL ADVISORY COMMITTEE TO THE ATOMIC ENERGY COMMISSION AND THE PRESIDENT'S SCIENCE ADVISORY COMMITTEE. (Panel of High Energy Accelerator Physics). Apr. 26, 1963. 61p.

Advances in elementary particle physics and briefly reviewed, and the need for higher energy and higher intensity facilities is discussed. Specific recommendations for future accelerators are given along with future needs of the accelerator program. Problems in accelerator physics are also examined, and international collaboration is considered. (D.C.W.)

24526 (UCRL-10654(Abridged)) ELECTRICAL DESIGN OF ELECTROSTATIC DEFLECTORS FOR SECTOR-FOCUSED CYCLOTRONS. Bob H. Smith and Hermann A. Grunder (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 25, 1963. Contract W-7405-eng-48. 19p.

The new sector-focused cyclotrons have more energetic and better focused beams at the extraction radius than do ordinary cyclotrons. While the first characteristic requires a more intense electric field, the second permits this field to extend over a smaller volume. By tailoring the electrode geometry to these characteristics of the beam, the required deflector gap and electrode surface become smaller, and a higher gradient can be held without sparking. A different compromise between radioactivity, power dissipation, and resistance to spark damage must be made in selecting electrode materials. Carefully designed electrostatic deflectors perform very well in sector-focused cyclotrons of intermediate energy. Deflector efficiencies of about 50% and external-beam intensities of 20 μamp have been obtained in the Lawrence Laboratory's 88-Inch cyclotron. (auth)

24527 (UCRL-10705) APPARENT HORIZONTAL SOURCE POSITIONS AND EXIT DIRECTIONS FOR NEGATIVE SECONDARY BEAMS FROM THE BEVATRON. Peter M. Goorjian (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 19, 1963. Contract W-7405-eng-48. 14p.

An explanation is presented for using the three "Source Maps" referring respectively to current markers 26, 29, and 33. These maps determine the apparent horizontal source position and exit path for any beams traveling in the median plane, which can emerge from an internal Bevatron target with a zero degree production angle. This information can be obtained in a few seconds using a straightedge. The method of map construction is described, and the probable uncertainty in source location is discussed. The various target magnifications are presented. (auth)

24528 (UCRL-10756) DIAGNOSIS AND CORRECTION OF BEAM BEHAVIOR IN AN ISOCHRONOUS CYCLOTRON. Alper A. Garren and Lloyd Smith (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 2, 1963. Contract W-7405-eng-48. 23p.

A description is given of methods used to observe phase behavior, orbit centering, and oscillation amplitude and frequencies in a cyclotron. These methods are being used to facilitate development of new 88-inch-cyclotron beams. Beam properties are deduced from the intensity as a function of radius, probe shadows, 3-finger and "C"-probe measurements. Required corrections make use of calculations based on magnet measurements. (auth)

24529 INVESTIGATION OF THE FORMATION OF AN ACCELERATED PARTICLE BEAM IN THE SYNCHRO-PHASOTRON BY MEANS OF INDUCTION ELECTRODES. G. S. Kazanskii, A. B. Kuznetsov, A. I. Mikhailov, N. B. Rubin, and A. P. Tsarenkov. At. Energ. (USSR), 14: 153-8(Feb. 1963). (In Russian)

Electrostatic signaling electrodes, consisting of wide Cu plates placed at both sides of the beam, are employed at the Dubna synchro-phasotron for recording the accelerated-particle beam. The plane of symmetry of the vertical electrode system coincides with the central plane of the magnet of the accelerator while the radial system lies orthogonally with respect to the first one. The signal induced in the vertical electrodes is proportional to the azimuthal variation of the particle charge density in the emitted cluster; the sensitivity of the instruments used in the vertical system is 1×10^{12} protons/v. The radial electrodes record the deviation of the beam in the horizontal plane; they have a sensitivity of 2 v/cm. The azimuthal structure of the beam may be observed about 100 to 150 μsec after applying the accelerating voltage. By choosing carefully the moment of application of this voltage on the basis of data from the signal electrodes, the energy spectrum of the beam leaving the linear accelerator may be determined. The oscillation processes controlled by the behavior of the particle beam during the first stage of the acceleration may be analyzed, using the results for optimizing the particle acceleration conditions. (TTT)

24530 A GENERALIZATION OF THE MCMILLAN-VEKSLER EQUATION. João Andrade e Silva and Georges Lochak (Laboratoire Joliot-Curie de Physique Nucléaire, Orsay, France and Institut Henri Poincaré, Paris). Compt. Rend., 256: 2131-3(Mar. 4, 1963). (In French)

The study of the region of applicability of the McMillan-Veksler equation shows that it is valid only for trajectories whose radius is several times larger than the corresponding distance between the dees. The problem of describing phase oscillations when this condition is not satisfied is discussed. A generalization of the McMillan-Veksler equation which will be valid near the center of the cyclotron is proposed. (J.S.R.)

24531 A NOTE ON THE PUMP ELECTRODES OF THE QUADRIPOLE AMPLIFIER. H. W. Tuffill and M. A. Wharmby (General Electric Co. Ltd., Wembley, Eng. and Hirst Research Centre, Wembley, Eng.). J. Electron. Control (1), 11: 47-51(July 1961). (In English)

The hyperbolic potential distribution of a quadripole amplifier (Adler et al.) is usually assumed to be produced by hyperbolic metal plates running along equipotential lines. It is shown that, to an approximation, the required field shape in the region occupied by the beam can be produced by four cylindrical poles. Equations are given for deriving the exact field shape. (D.L.C.)

24532 THE EFFICIENCY OF ELECTROSTATIC QUADRUPOLE AMPLIFIERS. H. J. Curnow (Services Electronics Research Lab., Baldock, Herts, Eng.). J. Electron. Control (1), 11: 161-76(Sept. 1961). (In English)

The operation of an electrostatic quadrupole cyclotron wave amplifier is examined both by an extension of small-signal theory and by exact large-signal calculations. The variations of axial velocity, the electrostatic pump potential's contribution to the total energy, and the true form of the twisted quadrupole field are taken into account. It is found that the efficiency depends on the rate of gain and, for the straightforward mode of operation discussed, is unlikely to exceed 25%. (auth)

24533 NEW TECHNIQUES FOR PARTICLE ACCELERATORS. F. A. Heyn (Technische Hogeschool, Delft, Netherlands). Ned. Tijdschr. Natuurk., 28: 293-326(Sept. 1962). (In Dutch)

A systematic examination is made of the most significant advances in circular accelerators. The topics discussed are guide fields, orbit stability, acceleration and longitudinal stability, resonances, and characteristics of particle pulses. In conclusion, recent developments in linear accelerators are indicated briefly. (J.S.R.)

24534 BEAM STACKING IN THE HARWELL SYNCHRO-CYCLOTRON. G. L. Salmon (Clarendon Lab., Oxford). Nucl. Instr. Methods, 21: 313-17(Feb. 1963). (In English)

Measurements were made of the energy displacements given to a coasting proton bunch in the cyclotron by r-f buckets accelerated past the orbital frequency of the protons. The results are in agreement with theoretical predictions and illustrate a limitation to the circulating current which can be built up in a beam-stacking accelerator. (auth)

24535 POWER SUPPLY FOR THE EXPANDER OF THE BETATRON. S. Oeines (Univ. of Bergen). Nucl. Instr. Methods, 21: 345-6(Feb. 1963). (In English)

A simple, inexpensive power supply was devised for the lengthened x-ray pulses from a 28-Mev betatron. The supply utilizes a power transformer of a few wire turns around the betatron core. (D.L.C.)

24536 AN IMPROVED BEARING ARRANGEMENT FOR VACUUM OPERATION OF THE ROTARY CONDENSER OF A SYNCHROCYCLOTRON. H. Hinterberger (Univ. of Chicago). Nucl. Instr. Methods, 21: 351-2(Feb. 1963). (In English)

The original bearings supporting the rotary condenser tend to wear out after 2 to 3 weeks. The rotary condenser suspension was modified to allow the sealing of the bearings in an oil bath. (D.L.C.)

24537 HIGH-INTENSITY NEGATIVE ION SOURCES. K. W. Ehlers, B. F. Gavin, and E. L. Hubbard (Univ. of California, Berkeley). Nucl. Instr. Methods, 22: 87-92 (Mar. 1963). (In English). (UCRL-10385)

The production of beams of negative deuterium ions was studied with two ion sources with geometries that could be employed in a cyclotron. The negative ions were extracted directly from the arc in a direction normal to the magnetic field without using a charge-exchange medium. With a high gas pressure in the arc and an arc current of 5 amp, a 2-ma beam of D^- ions was obtained. (auth)

24538 LIQUID HYDROGEN AND DEUTERIUM TARGET FOR USE WITH HIGH ENERGY ACCELERATORS. J. K. Walker, J. P. Burq, and V. Round (Faculte des Sciences, Orsay, France). Nucl. Instr. Methods, 22: 138-40(Mar. 1963). (In English)

A description is given of the construction ond operation of a liquid hydrogen and deuterium target which has proved useful in experiments with the 1 Bev electron linac of the Ecole Normale Supérieure. The essential features of the target are its relative simplicity of construction and ease of operation. In particular, the facility of filling and emptying the target appendix is provided by remote control with a switching time of about five seconds. Three successful experiments have been completed with the use of this target. (auth)

24539 STRONG MAGNETIC FIELD (A REVIEW). V. R. Krasik (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 6, 5-17(Nov.-Dec. 1962). (In Russian)

A review is given on the methods and techniques for developing strong magnetic fields. Pulse systems, d-c solenoids, superconducting magnets and other devices generating magnetic fields at 10^5 to 10^6 e are discussed. (tr-auth)

24540 ONE OF THE METHODS FOR ELECTRON ACCELERATION IN A RING PHASOTRON. A. A. Zhuravlev, V. I. Kotov, E. A. Myae, and V. A. Oboznyi (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 6, 18-21(Nov.-Dec. 1962). (In Russian)

Electron acceleration in a ring phasotron with combined electric vortex field and constant high-frequency field is described. Experimental data are given on high-frequency particle capture. The theory and experimental data are compared. (tr-auth)

24541 ELECTRON CAPTURE IN INDUCTION ACCELERATION IN A RING PHASOTRON. A. A. Zhuravlev, V. I. Kotov, E. A. Myae, V. A. Oboznyi, Yu. L. Obukhov, and E. Fisher (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 6, 21-4(Nov.-Dec. 1962). (In Russian)

Electron capture during the induction acceleration in a new-type (ring phasotron) synchrocyclotron is described and the experimental tests and results are analyzed. (tr-auth)

24542 A DEVICE FOR HIGH-FREQUENCY FREE OSCILLATION EXCITATION IN RING PHASOTRONS. E. A. Myae and V. A. Oboznyi (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 6, 25-8(Nov.-Dec. 1962). (In Russian)

Descriptions are given of a device for free oscillation resonance excitation in a ring phasotron. Observations of the pulse performance permit an accurate determination of free oscillation frequencies. (tr-auth)

24543 MAGNET POWER SUPPLY FOR THE 7 Gev PROTON SYNCHROTRON NIMROD. PART 1. GENERAL. P. Bowles, H. Hadley, M. J. Marchbanks, and J. J. Wilkins (National Inst. for Research in Nuclear Science, Harwell, Berks, Eng.). Proc. Inst. Elec. Engrs., (London), 110: 561-72(Mar. 1963).

A 7000-ton electromagnet forms part of the 7 Bev proton synchrotron Nimrod now under construction at the Rutherford High Energy Laboratory, Harwell. The design of the pulsed power supply for this magnet is outlined. The derivation of the power-supply requirements is given, and possible power supply systems are reviewed briefly. The evolution of the design of the selected system, namely

motor-alternator flywheel set plus a grid-controlled mercury-arc rectifier equipment, is discussed in some detail. 38 references. (auth)

24544 MAGNET POWER SUPPLY FOR THE 7 Gev PROTON SYNCHROTRON NIMROD. PART 2. ROTATING MACHINES. J. A. Fox (National Research in Nuclear Science, Harwell, Berks, Eng.), D. G. Taylor, and R. Wilson. Proc. Inst. Elec. Engrs., (London), 110: 573-90(Mar. 1963).

A part of the power supply for the orbital magnet of the 7 Bev proton synchrotron Nimrod. This machine is the first large accelerating device of the Rutherford High Energy Laboratory at the National Institute for the Research in Nuclear Science, Harwell. A description is given of the operational requirements of the power supply and its design, with particular reference to voltage regulators, to achieve repeatability of pulses; the shaft system, which must withstand the stresses occurring under normal pulsing and during faults; and the overall design of the set to limit the fluctuations of power taken from the grid. (auth)

24545 MAGNET POWER SUPPLY FOR THE 7 Gev PROTON SYNCHROTRON NIMROD. PART 3. MERCURY-ARC CONVERTORS. K. Rollig and H. Hoedle (Brown Boveri and Co. Ltd., Baden, Switzerland). Proc. Inst. Elec. Engrs., (London), 110: 591-602(Mar. 1963).

Some of the main problems concerning the mercury-arc converters feeding the guide magnet of the 7 Bev proton synchrotron are discussed. The duties of the convertor are discussed, with particular emphasis on the problems arising out of the interphase transformer cascade. The main elements of the control system are discussed; the grid control sets are considered separately as they represent a major portion of the control system. Finally, the various protective devices provided for the convertor installation are described. (auth)

24546 INTERACTIONS OF A SPATIAL CHARGE WITH HIGH-FREQUENCY FIELD IN CYCLIC ACCELERATORS. V. K. Grishin. Zh. Tekhn. Fiz., 33: 307-16(Mar. 1963). (In Russian)

Interactions between the longitudinal field of a beam and a high-frequency field were investigated in arbitrary cyclic systems and in $d\omega/dE < 0$ of weakly and strongly focusing systems with energy above critical, where ω is frequency and E is particle energy. Variability of beam parameters during acceleration and particle motion near the critical energy in a strong-focusing accelerator were investigated in addition to optimum acceleration conditions. Permissible magnitudes of possible parameter perturbations were estimated. (tr-auth)

24547 THE INFLUENCE OF ACCELERATED ELECTRONS ON THE TRAVELING WAVE PROPAGATION CONSTANT. G. I. Zhileiko. Zh. Tekhn. Fiz., 33: 316-19 (Mar. 1963). (In Russian)

The influence of an accelerated electron current on the propagation constant of a traveling electromagnetic wave in a diaphragmed waveguide was analyzed at electron energies <1 Mev (following electron bunching). It was found that the effect of accelerated electron beams (with currents of 1 to 2 amp and $\beta \approx 1$) on a constant traveling wave was negligible. Thus, the effect of the beam current on a wave propagation in a diaphragmed waveguide does not change the propagation constants, but reduces the wave amplitude, and as a result disturbs the synchronization between the wave and the accelerated electrons. (R.V.J.)

24548 THE INFLUENCE OF INDUCED VOLTAGE ON PHASE MOTION OF PARTICLE CLUSTERS IN ACCELERATORS. A. I. Baryshev and S. A. Kheifets. Zh. Tekhn. Fiz., 33: 320-5(Mar. 1963). (In Russian)

Effects of induced voltage on the phase motion of a particle beam passing through large gaps in an accelerator were analyzed. It was shown that under certain conditions a certain bond relation exists between resonator field oscillations and particle cluster phase oscillations. The bond affects damping and phase oscillation frequencies and may result in phase instability. The conditions producing such a bond were found. It was indicated that the examined effect is a function of the sign and magnitude of the resonator arrangement and may be used as a means for directing the particle cluster phase motion. (tr-auth)

24549 THE INFLUENCE OF MAGNETIC FIELD HETEROGENEITY ON PARTICLE MOTION IN A MICROTRON. V. P. Bykov (Moscow Inst. of Problems in Physics). Zh. Tekhn. Fiz., 33: 337-44(Mar. 1963). (In Russian)

It is shown that a weak magnetic field heterogeneity produces a drift in microtron orbit centers and an equilibrium phase shift. Formulas were derived for determining center drifts and equilibrium phase shifts for arbitrary heterogeneity. A concrete case of heterogeneity was examined in order to show that with increased orbit number the drift of orbit centers increases in proportion to the square of the number of orbits, while the shift of the equilibrium phase remains constant when the absolute magnitude of the field heterogeneity is constant. The obtained data are used for determining permissible heterogeneities in microtron fields. (tr-auth)

24550 ON THE PROBLEM OF BETATRON DEPENDENCE ON INJECTION ENERGY. A. I. Pavlovskii, G. V. Sklizikov, G. D. Kuleshov, and A. I. Gerasimov. Zh. Tekhn. Fiz., 33: 374-6(Mar. 1963). (In Russian)

An attempt was made to increase betatron and synchrotron yields at injection energies to 300 kev. An iron-free betatron with homogeneous phase and azimuthal magnetic field not exceeding 0.5% was used in the experiment. The results showed that the capture process does not depend on the method of injection, and the intensity dependence on W (injection energy) is linear to 120 kev and stronger with further energy increase. Up to 280 kev the dependence of W and K (capture coefficient) is very weak, and there is only a slight dependence of the maximum energy on the shape and duration of injection pulses at 0.15 to 2 μsec. (R.V.J.)

24551 EXIT PARAMETERS AND WORKING CHARACTERISTICS OF LINEAR ELECTRON ACCELERATORS. N. M. Gavrilov, S. P. Lomnev, O. S. Milovanov, E. G. Pyatnov, G. A. Tyagunov, and A. V. Shal'nov. p.75-82 of "Uskoriteli. No. 3." Moscow, Gosatomizdat, 1962.

The working characteristics, obtained with an electronic computer, of 2- to 26-Mev linear electron accelerators, are presented. By working characteristics are meant the different dependences of the exit parameters of the accelerator (maximum energy, width of the energy spectrum, phase width of clusters) on the energy and flux of injected particles, as well as on the frequency and power of the h-f feed. (Referativnyy zhurnal, Fizika, No. 10, 1962)

24552 VARIATIONAL CHARACTERISTICS OF THE BUNCHER OF A LINEAR ELECTRON ACCELERATOR. S. P. Lomnev. p.83-97 of "Uskoriteli. No. 3." Moscow, Gosatomizdat, 1962.

The changes of the phase velocity of a wave, of the accelerating field amplitude, $E_0(z)$, and of other characteristics of the waveguide due to temperature fluctuations, and also of other kinds due to instabilities of the h-f oscillator, of the energy and current of injected particles, were investigated for their effect on the exit parameters of the beam of a waveguide buncher. The investigation was con-

ducted with numerical methods for different $E_{\theta max}$ values. Results are given in the form of tables and diagrams. (Referativnyy zhurnal, Fizika, No. 10, 1962)

24553 WAVEGUIDE BUNCHER OF A LINEAR ELECTRON ACCELERATOR. S. P. Lomnev. p.98-114 of "Uskoriteli. No. 3." Moscow, Gosatomizdat, 1962.

The effect of the accelerating field amplitude, $E_\theta(z)$, and of the phase velocity, $\beta_w(z)$, of a wave on the grouping and the spectrum of accelerated electrons was investigated numerically. The calculation was made for some values of $E_{\theta max}$ (15 to 180 kv/cm) and $\beta_{wi} = 0.2$ to 0.5 (for $\beta_{wi} = \beta_{ei}$); the case is also considered, when $\beta_{wi} = \beta_{ei}$, where β_{wi} and β_{ei} are the initial values of phase and electron velocity, respectively. (Referativnyy zhurnal, Fizika, No. 10, 1962)

24554 ON THE SIMILARITY OF LINEAR ACCELERATOR-BUNCHERS. E. G. Pyatnov. p.115-20 of "Uskoriteli. No. 3." Moscow, Gosatomizdat, 1962.

The possibility of applying calculated results relating to a waveguide buncher designed for operation on a nominal wavelength (in the range of 9 to 11 cm) to other bunchers with approximately the same exit parameters of the accelerated beam, but intended for operation on another wavelength within the same range, was studied. It is shown that if the bunchers have equal geometrical dimensions (in units of the nominal wave-length), the maximum divergences in h-f power and in their electric field strength will not exceed 6 and 3%, respectively; energy and final phase in the spectral maxima are shifted by $\leq 2\%$ from their values; the spectrum shapes practically do not change. (Referativnyy zhurnal, Fizika, No. 10, 1962)

24555 APPLICATION OF WILKINSHOW'S METHOD TO THE CALCULATION OF THE GEOMETRY, FIELDS, AND ATTENUATION IN THE WAVEGUIDE OF A LINEAR ELECTRON ACCELERATOR. S. P. Lomnev. p.141-7 of "Uskoriteli. No. 3." Moscow, Gosatomizdat, 1962.

An approximate method for calculating the geometry of the diaphragm waveguide of a linear accelerator was numerically investigated. It is shown that the best agreement between calculated and experimental values is obtained for $n = 4$ terms of the dispersion equation. An increase of n lowers the accuracy. (Referativnyy zhurnal, Fizika, No. 10, 1962)

24556 STUDY OF AN ANNULAR MULTITERMINAL NETWORK AS A FEEDBACK BRIDGE OF A LINEAR ELECTRON ACCELERATOR. V. G. Lopato. p.192-7 of "Uskoriteli. No. 3." Moscow, Gosatomizdat, 1962.

The results of an experimental study of a waveguide annular multiterminal network used in the h-f power recovery circuit of a linear accelerator are presented. They agree with previous theoretical and experimental calculations. (TCO)

Plasma Physics and Thermonuclear Processes

Refer also to abstract 22973.

24557 (AD-286404) A STUDY OF AN INDUCTION-COUPLED PLASMA OPERATING AT 400 KILOCYCLES (thesis). Howard R. Cannon (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1962. 71p. (GA/Phys/62-2)

A r-f electrodeless plasma-generator was developed which operated at peak plasma powers of 50 kw. The plasma was vortex stabilized, and was contained within a water-cooled Vycor tube. Power was measured calorimetrically. Radiation power was measured by alternately using clear water and water made opaque with India ink to cool the Vycor tube. A model temperature profile was deduced from spectrographic measurements transverse to the plasma axis. Maximum plasma temperatures were shown to exist in a thin cylindrical sheath near the plasma surface, with relatively cooler temperatures existing at the center-line gas back-flow. Effects of changing gas flow-rate, gas composition, r-f power, and Vycor tube diameter on the effectiveness of the energy coupling mechanism are shown. (auth)

24558 (ARL-62-460) DEVELOPMENT OF METHODS FOR QUANTITATIVE SPECTROSCOPIC TEMPERATURE DETERMINATION OF PLASMAS. Jans Juergen Kusch (Kiel. Universitat. Institut fur Experimentelle Physik). June 30, 1962. 37p.

Three ways to obtain plasmas with temperatures up to 100,000°K were tested. The first approach—pulsing an arc by high current—was not as successful as desired because confinement breaks down. The second experiment was a linear pinch. In the center of the discharge temperatures higher than 80,000°K could be measured, the radiation being emitted from thermally excited atoms. The third way involved the magnetic compression of a preionized discharge in helium by an outer magnetic field. Preionization was effected by use of a pulsed discharge fed by a capacitor bank. Plasma parameters were determined by quantitative spectroscopic methods. Distributions of plasma parameters in space and time could be investigated by time resolved spectroscopy. Electron density rises to more than 10^{18} cm^{-3}; temperature was found to be 70,000°K at most. Several methods to determine plasma parameters yielded the same results, thus proving the plasma to be in local thermodynamic equilibrium. Radiation was found to be emitted from optically thin layers. With more energy stored in the capacitor bank feeding the magnetic field and with more effective preionization, a further increase in temperature may be expected. (auth)

24559 (ML-1024) STUDIES OF PLASMA OSCILLATIONS. Quarterly Status Report No. 13, December 1, 1962—February 28, 1963. (Stanford Univ., Calif. Microwave Lab.). Apr. 1963. Contract AT(04-3)-326. 25p.

Expressions for collision and ionization damping of ion waves for various geometries and boundary conditions were derived. Diffusion losses, on which the ionizing frequency depend, were noted to be generally controlled by the smallest dimension in rectangular section discharge tubes. If the boundary was a potential maximum, however, the minimum frequency depended on the longest dimension, and the attenuation was very high. An experiment was conducted in which ion waves were deliberately excited in a mercury discharge column in a weak axial magnetic field. The phase shifts were measured directly, and the waveform of the detected light was displayed on an oscilloscope. The wave was noted to appear at twice the driving frequency as zero static magnetic field was approached. Limitations and potentialities of a double-probe system for rapidly determining the electron velocity distribution in a discharge were studied theoretically and experimentally. The technique seems feasible if positive ion probe cleaning is practiced, but errors are somewhat high and hard to reduce. Theory for a high-frequency number-density diagnostic technique involving dipole resonances of the discharge column was extended to cover plasmas in axial magnetic fields. Experiments proved the assumed number density/current proportionality to be invalid, but

showed that with frequency variation the theory is followed up to about $\omega_c/\omega_0 \approx 0.45$, where ω_c is the electron cyclotron frequency. Preliminary considerations indicate that Langmuir's paradox for low-pressure mercury arcs does not exist and that a d-c solution for it can be found. (D.C.W.)

24560 (NP-12797) A MAGNETIC ANNULAR ARC. Research Report 129. W. E. Powers and R. M. Patrick (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). May 1962. Contract AF49(638)-659. 33p.

Supersedes AMP-54.

The performance characteristics of an annular arc configuration under the influence of a magnetic field were experimentally analyzed, particularly with respect to the effects of tensor conductivity and $j \times B$ body forces. In this device the plasma conditions are such that the electrical conductivity is insufficient to prevent the diffusion of the plasma through the magnetic field, i.e., the magnetic Reynolds number was small. Experiments were conducted with this device using helium and argon at power levels up to 50 kw, magnetic field strengths to 10,000 gauss and particle densities of the order of $10^{16}/cm^3$ to $10^{17}/cm^3$. The electron gyro radius was smaller than the electron mean free path, i.e., $\omega_e\tau_e > 1$, where ω_e is the gyro frequency, and τ_e is the time between collisions for electrons. The impedance of the arc in helium was found to vary linearly with $\omega_e\tau_e$. The existence of a circulating azimuthal Hall current was also demonstrated. A yaw probe was employed to measure the angle of the flow due to the $j \times B$ Lorentz forces. A good agreement was found between the measured rotation in argon and the predicted value obtained from momentum considerations. (auth)

24561 (PIBMRI-1112-63) RESEARCH IN ELECTROMAGNETICS, PLASMAS AND NETWORKS. Final Report. L. B. Felsen (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Feb. 13, 1963. Contract AF19(604)-4143. 58p. (AD-402313; AFCRL-63-53)

Research in electromagnetics and network theory is summarized. The electromagnetics program involved a broad study of wave propagation and diffraction phenomena in layered or inhomogeneous media; in anisotropic media; and by variously shaped objects having constant or variable surface impedance properties. Current topics involving plasmas motivated the analyses, and practical applications were considered in devising problems to be analyzed. Some of the results of the networks program are extensions of well established theorems while others contain answers to original and previously unsolved problems. In particular, a firm structure for Darlington synthesis was finally erected. The outstanding problem of optimum multiple-channel filter design was solved completely for the case of rational spectral densities. 31 references and lists of reports and memoranda published, papers published in scientific journals, and talks presented at technical meetings are also included. (auth)

24562 (R62SD47) MICROWAVE REFLECTION BY NON-UNIFORM PLASMA WITH EXPONENTIAL ELECTRON DISTRIBUTION. K. T. Yen (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). May 1962. 24p.

Microwave reflection by non-uniform plasmas with an exponential electron distribution that approaches an equilibrium value far downstream is considered. Several approximate formulas for the reflection coefficient and phase-shift angle are presented. Some numerical calculations have been carried out, and the results are presented in graphs. Comparison of the present results with those for "ramped" electron distributions shows an interesting point; i.e., when piecewise linear segments are used to represent a continuous electron distribution, the wave interactions thus produced may have significant effects for the reflection and transmission of electromagnetic waves. (auth)

24563 (UCRL-10379) RADIAL POTENTIAL DISTRIBUTIONS IN A POSITIVE COLUMN IN A MAGNETIC FIELD. George A. Paulikas and Robert V. Pyle (California. Univ., Berkeley. Lawrence Radiation Lab.). July 31, 1962. Contract W-7405-eng-48. 32p.

The radial distributions of floating potential in the positive column of a glow discharge in a longitudinal magnetic field were measured with electric probes designed to minimize the perturbation of the plasma. Ecker has shown that the shape of these distributions can provide a sensitive indication of the presence of enhanced electron-ion interactions. No evidence for enhanced interactions is noted; at magnetic field strengths below the threshold of the previously observed helical instability; the results are compatible with the classical ambipolar theory of the positive column. (auth)

24564 (UCRL-10399) BOUNDARY EFFECTS IN ROTATING-PLASMA EXPERIMENTS. Wulf B. Kunkel, William R. Baker, Alexander Bratenahl, and Klaus Halbach (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 2, 1962. Contract W-7405-eng-48. 33p.

The problem of current continuity and viscous drag at the boundaries in rotating-plasma experiments is discussed. A hypothetical model having a steady state with axial symmetry is emphasized; it is shown that the discharge impedance derived from this model does not agree with many observations. The "Homopolar III" experiment is described in which the flux surfaces were strongly convex and parallel to the toroidal-shaped electrodes. In this way friction at the insulators was reduced. But the structure of the discharge deviated drastically from axial symmetry near the outer surface. Several studies led to the conclusion that the flow pattern probably involved secondary flows. A detailed analysis of this structure was not possible. It was also found that the rotational speed could not be raised above a few cm/μsec because the insulators failed in spite of the special design of the experiment. 28 references. (auth)

24565 (UCRL-10740) ABSTRACTS OF PAPERS TO BE PRESENTED AT THE MEETING ON THEORETICAL ASPECTS OF CONTROLLED THERMONUCLEAR FUSION HELD AT UNIVERSITY OF CALIFORNIA, LAWRENCE RADIATION LABORATORY, BERKELEY, CALIFORNIA, APRIL 8-9, 1963. (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1, 1963. Contract W-7405-eng-48. 31p.

Abstracts for twenty-six papers dealing with plasma stability, particle motion in plasmas, radiations from plasmas, stabilization of mirror machines, characteristics of plasmas, particle-wave interactions in plasmas, hydrodynamics of a coulomb gas, and the non-relativistic quantum electrodynamics of plasmas are presented. (D.C.W.)

24566 (AEC-tr-5809) ION SOURCES. Albert Ziegler. Translation of German Patent 1,001,429. June 27, 1955. 10p.

An ion source in which an almost completely ionized plasma of high temperature, velocity, and ion density is produced by an electric arc arrangement that uses large pressure differences between the electrode spaces is described. Various set-ups for plasma extraction are provided. (D.C.W.)

24567 (AERE-Trans-925) MICROWAVE PLASMA DIAGNOSTICS. L. A. Dushin, V. I. Kononenko, V. I. Privezentsev, A. I. Skibenko, and V. T. Tolok. Translated by J. Stuart (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from "Plasma Physics and Problems of Controlled Nuclear Fusion," a publication of Publishing House of the Academy of Sciences, Kiev, 1962. 12p.

Methods for determining electron density, electron density distributions, and collision frequencies in plasma from microwave attenuation, phase shift, and passage in plasma are briefly discussed. The methods utilize arrangements in which the microwave electric field is parallel to the external magnetic field. (D.C.W.)

24568 PERTURBATIONS PRODUCED IN A PLASMA BY A RAPIDLY MOVING BODY. L. P. Pitaevskii (Inst. of Terrestrial Magnetism, the Ionosphere, and Radio-Wave Propagation, Academy of Sciences, USSR). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 994-1000(Apr. 1963). Translated by Faraday Translations, New York.

The kinetic equation is used to find expressions for the Fourier components of the electron-density perturbation resulting from the passage of a body whose speed is much greater than the thermal velocity of the ions. The plasma is in a fixed magnetic field, such that the Larmor radius for the ions is much greater than the size of the body. The formulas are used to find the effective scattering cross section for electromagnetic waves whose wavelength is much greater than the size of the body. (auth)

24569 USEFUL IDENTITIES FOR HALF-SPACE PROBLEMS IN LINEAR TRANSPORT THEORY. R. E. Aamodt and K. M. Case (Univ. of Michigan, Ann Arbor). Ann. Phys. (N. Y.), 21: 284-301(Feb. 1963).

A typical translationally invariant linear transport problem for a half-space is solved by the eigenfunction method. Using some derived identities for the solution of the associated homogeneous Hilbert problem it is shown that the usual cumbersome integrals occurring in half-space problems can be reduced to a simple form. The usefulness of the identities is illustrated by solving the problem of a plasma confined to a half-space by a diffuse reflecting wall. (auth)

24570 GROWING TRANSVERSE WAVES IN A PLASMA IN A MAGNETIC FIELD. Peter D. Noerdlinger (Univ. of Chicago). Ann. Phys. (N. Y.), 22: 12-53(Apr. 1963).

Instabilities in uniform collisionless plasmas may be relevant to the understanding of several astrophysical and geophysical problems and to the confinement of plasmas in the laboratory. A practicable method for ascertaining the instability of such plasmas in a uniform steady magnetic field with respect to disturbances propagating along the direction of that field is presented. The method is applied to two examples of plasmas having anisotropic pressure, that is, having the pressure $p_{||}$ along the steady magnetic field not equal to the pressure $p_{\perp}$ perpendicular to the field. The examples given are those of an electron plasma and of a plasma with two species having equal masses and opposite but equally large charges. The latter example is treated because it is mathematically simpler than an electron–ion plasma, and is referred to as an electron–positron plasma. In both examples when $p_{\perp} > p_{||}$ unstable electromagnetic type waves occur for all values of the d-c magnetic field strength. When $p_{\perp} > p_{||}$ a new family of unstable hydromagnetic waves is found in the electron–positron plasma. Steady waves with frequency $\Omega(p_{\perp} - p_{||})/p_{\perp}$, where Ω is the electron gyrofrequency, are found in both examples for $p_{\perp} > p_{||}$. When $p_{||} > p_{\perp}$, classical results for the hose instability are recovered and are extended outside the guiding center limit in the case of the plasma with two oppositely charged species. The electron gas with fixed neutralizing background is found to be stable for $p_{||} > p_{\perp}$. Most of the results are found to be applicable to real (electron–ion) plasmas. Growth rates of unstable waves are treated in some detail. (auth)

24571 COLLECTIVE ASPECTS OF BREMSSTRAHLUNG EMISSION AND ELECTRICAL CONDUCTIVITY IN A PLASMA. Otto Theimer (New Mexico State Univ., University Park). Ann. Phys. (N. Y.), 22: 102-22(Apr. 1963).

The bremsstrahlung spectrum and the a-c electrical conductivity of a plasma are calculated, by classical methods, from a model in which the electrons interact with the plasma as a whole, and not with individual particles. The Fourier expansion of the particle density is employed for calculating the time dependent electrical field at the position of a moving electron, and the Fourier coefficients of the electrical field are used for calculating the bremsstrahlung emission and the conductivity. The method clearly exhibits the relation between these two quantities and gives a fairly rigorous expression for the cutoff parameter p_{max} as a function of the Debye shielding length, the electron mean free path, and the frequency of the electrical field. (auth)

24572 ABSORPTION COEFFICIENT AND MICROWAVE CONDUCTIVITY OF PLASMAS. P. Mallozzi and H. Margenau (Yale Univ., New Haven). Astrophys. J., 137: 851-7 (Apr. 1, 1963).

The quantum derivation of an expression for the absorption of microwaves in a fully ionized plasma leads one to conclude that Coulomb collisions cannot, under steady, isotropic conditions, amplify microwaves. The same result was deduced from a consideration of the conductivity formula. It is shown that the absorption resulting from the real part of the conductivity of a plasma is, in general, identical with that implied by the absorption coefficient, even though the former is computed on the basis of Boltzmann's equation, the latter by radiation theory. (auth)

24573 COULOMB COLLISION-INDUCED DIFFUSION OF PLASMA IN A MAGNETIC FIELD. S. G. Alikhanov, V. E. Zakharov, and G. L. Khorasanov. At. Energ. (USSR), 14: 137-42(Feb. 1963). (In Russian)

The coefficients which determine the diffusion in the fully ionized plasma play a controlling role in the establishment of a diffusion stream in the transverse direction to the magnetic field. If the experimental conditions are such that the Coulomb collisions become preponderant, these coefficients may be measured at relatively low ionization levels. The required conditions are fulfilled in a disintegrating plasma because at relatively low temperatures of the electron gas the collision cross section of the electrons with ions is several orders of magnitude larger than that of electrons with neutral particles. An ultrahigh-frequency method was used for the study of the diffusion of the disintegrating plasma. The experimentally obtained diffusion coefficients in magnetic fields up to 700 to 800 oersted were compared with those calculated on the basis of the classical Coulomb pair collision theory. In the 1000- to 5000-oersted region the data obtained deviated strongly from the calculated values, as the diffusion coefficient was found to be proportional to 1/H. An asymptotic solution was derived for the diffusion equation, defining the disintegrating ionized plasma for the case of axial symmetry. (TTT)

24574 THE EXPERIMENTAL PLASMA FACILITY S-1, PROVIDED WITH SCREW MAGNETIC FIELDS. I. P. Afonin, B. I. Gavrilov, E. K. Zavoiskii, F. V. Karmanov, G. P. Maksimov, A. G. Plakhov, P. A. Cheremnykh, and V. V. Shapkin. At. Energ. (USSR), 14: 143-50(Feb. 1963). (In Russian)

In the screw-type magnetic fields, first proposed by L. Spitzer, Jr. and his coworkers, and in the absence of large longitudinal currents, plasma is magnetohydrodynamically stable; in order to investigate this problem experimentally, a machine similar to the stellarator was constructed. Studies on the containment of the plasma indicated that the charged particles leave the system at a faster rate than was expected. This might be due to slightly inaccurate positioning of the components generating the magnetic field but could be caused by as yet unexplained processes taking place in the plasma. The "racetrack"-shaped machine has an internal diameter of the vacuum chamber of 10 cm, a straight-line portion of 120 cm, and an average radius of curvature of 60 cm; the total length of the perimeter is 617 cm. The longitudinal magnetic field may reach values up to 25 kilo-oersted while the value of $H_\perp/H_0$, determining the screw field, may assume values ranging from 0.2 to 0.6. The first experiments on ohmic heating were completed recently. Preliminary tests carried out at various He pressures indicated that by decreasing the pressure, the effect of the screw-type windings on the course of the discharge increases. (TTT)

24575 THEORY OF THE THIN FIN IN MAGNETO-AERODYNAMICS. Lazare Dragos (Univ. of Bucharest). Compt. Rend., 256: 2772-4(Mar. 25, 1963). (In French)

The motion of a conducting compressible fluid in the presence of thin fins was studied by developing the linear theory on the supposition that in the nonperturbed current, at infinity, the magnetic field has the same direction as the flow of the fluid current. The same problem is studied by assuming that at infinity the direction of the magnetic field is perpendicular to the direction of the flow. (J.S.R.)

24576 VARIATIONAL SOLUTION OF THE RESONANCES OF A PLASMA. APPLICATION OF THE PRINCIPLE TO CYLINDRICAL AND SPHERICAL SYSTEMS. Frédéric Crawford and Gordon Kino (Centre d'Etudes Nucleaires, Saclay, France and Stanford Univ., Calif.). Compt. Rend., 256: 2798-2800(Mar. 25, 1963). (In French)

A variational principle applicable to the determination of the resonance frequency of a system composed of conductors and dielectrics containing a plasma was previously established (Compt. rend., 256: 1939(1963)). This result is applied to systems having a cylindrical or spherical symmetry. (tr-auth)

24577 "COLLISIONLESS" SHOCK WAVE IN A LINEAR PINCH EXPERIMENT. Jean-Louis Bobin (Commissariat à l'Énergie Atomique, [Paris]). Compt. Rend., 256: 2801-4(Mar. 25, 1963). (In French)

The low luminosity during the compression stage as well as the absence of a discernible shock front have shown that the mechanism of gas contraction is a collisionless shock wave. (tr-auth)

24578 EVIDENCE IN A COLD CATHODE REFLEX DISCHARGE OF AN INSTABILITY OF THE "TWO BEAMS" TYPE. Samuel Bliman (Faculté des Sciences, Orsay, France). Compt. Rend., 256: 3034-7(Apr. 1, 1963). (In French)

In a cold-cathode reflex discharge, a region of operation was found in which the discharge acts as a system with two electron beams. An instability is produced which seems to correspond to that predicted by M. N. Rosenbluth. (tr-auth)

24579 SYMMETRICAL MAGNETOHYDRODYNAMIC FLOW. A. I. Morozov and L. S. Solov'ev. Dokl. Akad. Nauk SSSR, 149: 550-3(Mar. 21, 1963). (In Russian)

Equations were derived that describe the stationary flow of an ideally conducting, compressible fluid in a magnetic field with helical symmetry. A number of examples of plane and axial-symmetric flow are considered. It is assumed that the flow lines of the fluid lie on the surfaces $\psi_0(r,\theta)$ = const, the magnetic force lines lie on the "magnetic surfaces" $\psi(r,\theta)$ = const, the electric current lines lie on the surfaces $I(r,\theta)$ = const, and the vortex lines lie on the surfaces $I_0(r,\theta)$ = const. All these surfaces have helical symmetry. Here r and $\theta \equiv \phi - \alpha z$, where r, ϕ, and z are cylindrical coordinates, and $L \equiv 2\pi/\alpha$ is a constant equal to the pitch of the helix. Since the liquid flows along the magnetic surfaces, it follows that $\psi_0 = \psi_0(\psi)$, and on introducing a new function ξ for symmetry, it can be considered that $\psi_0 = \psi_0(\xi)$, and $\psi = \psi(\xi)$. The full set of equations for helical symmetry at $S(\xi)$ = const is presented (here S is the entropy). The cases of plane flow ($\alpha \to 0$), and of axial-symmetric flow (as $\alpha \to \infty$) are derived from these equations as limiting cases. (TTT)

24580 THE FREQUENCY OF NON-LINEAR PLASMA OSCILLATIONS. H. Derfler (Stanford Univ., Calif.). J. Electron. Control (1), 11: 189-92(Sept. 1961). (In English)

The frequency of plane standing waves of electron moving through a background of infinitely heavy ions is strictly independent of amplitude as long as the electron velocity is a unique function of position. This result is contrary to those presented in recent publications by Amer (1958) and Gold (1959). The frequencies of spherical and cylindrical plasma oscillations, however, do depend upon the amplitude of the oscillation. As a result any phase relationship between electrons eventually will be destroyed and the electron velocity becomes multivalued. Therefore, steady free oscillations do not persist even in a cold plasma. (auth)

24581 PLASMA SURFACE PRESSURE AS A CONSERVATIVE, EXTRANEOUS BODY FORCE. Richard L. Moore (Richard L. Moore Consultants, Los Angeles). J. Electron. Control (1), 11: 213-24(Sept. 1961). (In English)

The usual assumptions of continuum hydrodynamics plus a condition of analyticity to determine the functional form of the extra stress in the direction parallel to the surface are applied to a bounded plasma in a magnetic field. The rest configuration at uniform temperature is shown to have a gaussian density distribution. An equivalent irrotational body force is derived for use in the equation of motion which is the negative gradient of the potential energy of a perfect conductor in a magnetic field. Scaling laws of classical hydrodynamic type are also contained. (auth)

24582 DIELECTRIC CONSTANT OF A PLASMA. J. W. Gallop, T. L. Dutt, and H. Gibson (English Electric Co. Ltd., Stafford, Eng.). J. Electron. Control (1), 11: 225-6(Sept. 1961). (In English)

In a previous paper (J. Electron. Control 10: 207(1961)), an elastic restoring force was used in the equation of motion for the electron in order to take account of plasma resonance effects. It is shown that this force was based on experimental evidence. The justification of this force is discussed. (D.L.C.)

24583 EXACT STATISTICAL MECHANICS OF A ONE-DIMENSIONAL SYSTEM WITH COULOMB FORCES. III.

STATISTICS OF THE ELECTRIC FIELD. Andrew Lenard (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 4: 533-43(Apr. 1963). (MATT-144)

The statistics of the electric field in a one-dimensional sheet plasma is studied. It is shown that the electric field as a function of the space coordinate is a Markov process, whose basic probabilities are related to the Fourier coefficients of certain functions that play an important role in the previously found development of the grand partition function. Some implications regarding the statistics of particle locations are explored. The one-point probability distribution of the electric field is found to be asymptotically Gaussian in the plasma limit. It is pointed out that the one-dimensional analog of the Holtsmark calculation leads to an incorrect conclusion because electrostatic shielding is not properly taken into account. (auth)

24584 LYAPUNOV'S STABILITY CRITERIA FOR PLASMAS. T. K. Fowler (Oak Ridge National Lab., Tenn.). J. Math. Phys. (N. Y.), 4: 559-69(Apr. 1963).

The orbit stability theory of Lyapunov was adapted to the Vlasov-Boltzmann equation governing plasmas. Both linear and nonlinear stability are considered. The theory is characterized by a search for Lyapunov functions, whose existence implies stability in analogy with particles trapped in a potential well, as in the energy principle. The most important result is an existence theorem for Lyapunov functions quadratic in perturbations in all linearly stable cases in which perturbations damp asymptotically. As a corollary, without damping, the existence of a quadratic Lyapunov function is necessary and sufficient to prevent exponential growth of perturbations. A prescription is given for finding Lyapunov functions that are constants of motion. An example is treated. The implication of nonlinear stability from linear stability with damping is discussed, and a direct proof of nonlinear stability of a Maxwellian plasma by Lyapunov's method is reported. (auth)

24585 STABILITY OF POSITIVE COLUMN IN A STRONG MAGNETIC FIELD. Michio Matsumoto (Tokyo Inst. of Tech.). J. Phys. Soc. Japan, 18: 572-8(Apr. 1963).

The instability of positive column is investigated theoretically, under the assumption that the densities of electrons and ions are perturbed independently. The electric field induced by these perturbations is derived exactly by solving Poisson's equation. For helical perturbations, the existence of a finite potential at the wall is found. A relation between the critical magnetic field above which the perturbation is unstable and the corresponding electric field is obtained. It depends upon the discharge current; and this dependence is in good agreement with Hoh and Lehnert's experiments. (auth)

24586 MEASUREMENT OF ELECTRON TEMPERATURE OF A PLASMA BY MICROWAVE METHOD. Yuichi Sakamoto and Syoichi Miyoshi (Inst. of Physical and Chemical Research, Tokyo). Japan. J. Appl. Phys., 2: 245-9 (Apr. 1963). (In English)

Thermal radiation in 9000 Mc/sec region emitted from a steady plasma without external magnetic field is received by a microwave horn antenna and measured with an electric field meter. The electron temperature is obtained, taking by antenna factor and the absorptivity of the plasma into consideration. Langmuir probe measurements are also made. Both results show good agreement. A method for measuring the absorptivity of a plasma in the far field by the use of antenna is investigated both theoretically and experimentally. (auth)

24587 THE LATEST STEPS TOWARDS FUSION POWER. Peter Stubbs. New Scientist, 18: 258-9(May 2, 1963).

A brief review of progress in the field of plasma containment, the apparatus used, and the problems to be overcome in obtaining controlled fusion power is presented. (C.E.S.)

24588 INTERPRETATION OF EXPERIMENTAL RESULTS OBSERVED IN THE CONFINEMENT BY H. F. FIELDS AND STATIC MAGNETIC RESONANCE. T. Consoli, R. Le Gardeur, G. Mourier, P. Vial, R. Roux (Centre d'Etudes Nucleaires, Saclay, France). Phys. Letters, 4: 89-91(Mar. 15, 1963). (In French)

The experimental results previously reported (Phys. Letters, 1: 267(1962)) are tentatively interpreted using four designs. If the self-field reduces locally the static field, resonance is possible on both sides of the median plane of symmetry only where the initial static field reduced from the self-field can engender two new rings. The plasma resulting from the bursting of the central ring forms a plasma sphere that is trapped in the small magnetic bottle. This structure remains stable until the end of the pulse. When the neutral pressure is higher, this evolution is not observed, but the formation of a cylindrical bed is. A probable prolongation of the preceding phases is given. (J.S.R.)

24589 CONTRIBUTION OF CONFINEMENT BY H. F. FIELDS TO THE ANALYSIS OF FORMATION MECHANISMS OF QUASI RELATIVISTIC ELECTRON LAYERS OBSERVED IN AZIMUTHAL STRICTIONS. T. Consoli, R. Le Gardeur, G. Mourier, P. Vial, and R. Roux. Phys. Letters, 4: 106-8 (Mar. 15, 1963). (In French)

A resonance phenomenon observed in confinement by crossed fields (very high frequency electric field perpendicular to the static magnetic field) is described. This phenomenon leads apparently to the stable confinement of a plasma sphere. The experimental study of the evolution of the phenomenon, as well as its interpretation, seems to prove a relation with the Θ pinch. (tr-auth)

24590 PLASMA DIPOLE RESONANCE IN THE PRESENCE OF A MAGNETIC FIELD. F. W. Crawford and G. S. Kino (Stanford Univ., Calif.). Phys. Letters, 4: 240-2(Apr. 15, 1963). (In English)

The theory and technique for determining the plasma dipole resonance frequency in a transverse electric field is applied to the case of a plasma in an axial d-c magnetic field. The frequency variation is in good agreement with theory over the range of magnetic field in which the resonances can be observed. (C.E.S.)

24591 ON THE INFLUENCE OF IDENTICAL CHARGED PARTICLES ON PLASMA DIFFUSION ACROSS A STRONG MAGNETIC FIELD. V. E. Golant (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 257-62(Mar. 1963). (In Russian)

Collisions of identical particles resulted in variable rates of electron and ion diffusion across magnetic fields and in separation of plasma charges. Diffusion effects of heterogeneous electric fields produced by charge separation were studied. The field evolves a bipolar diffusion mechanism in completely ionized gas. It is shown that the bipolar diffusion flux, related to the collision of identical particles, at Larmor ion radii is neglibibly small and is much smaller than the characteristic plasma dimensions. (tr-auth)

24592 THE INFLUENCE OF ALTERNATING FIELD HETEROGENEITY ON THE PROPERTIES OF HIGH-FREQUENCY DISCHARGE. V. I. Perel and Ya. M. Pinskii (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 268-75(Mar. 1963). (In Russian)

An equation was obtained for the mean force acting upon an electron at the boundary of a heterogeneous high-frequency field in which electrons collide with gas atoms. High-frequency discharge between plane electrodes was investigated, and it is shown that plasma concentrates in the central discharge region. The drop in high-frequency intensity takes place mainly in the pre-electrode region. Particle concentrations, and field distributions, balance, and volt-ampere characteristics were determined. (tr-auth)

24593 ON HEATING OF MULTI-CHARGED ADMIXTURE IONS IN PLASMA. A. V. Gurevich and Yu. N. Zhivlyuk (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 276-90(Mar. 1963). (In Russian)

The behavior of multicharged admixture ions in a strongly ionized plasma containing electrons and singly charged ions, placed in a constant electric field, was analyzed. At high electric field intensity the multicharged ions are not in thermal equilibrium with the other plasma particles. Moreover, they have a singular equilibrium energy that exceeds the mean energies of plasma electrons and basic ions by an order of one to three. (tr-auth)

24594 SPECTROSCOPIC STUDIES OF COLLECTIVE MOTION OF N(IV) IN "ALPHA" INSTALLATION. A. B. Berezin, A. N. Zaidel, and G. M. Malyshev (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 291-5 (Mar. 1963). (In Russian)

Luminescence intensities of two half-lives of N(IV) with $\lambda = 3479$ Å were investigated. Observed counter phase intensity oscillations were interpreted as the result of collective motions. The contribution of collective motion in Doppler broadening of the line does not exceed 20%. (tr-auth)

24595 ON RESONANCE INTERACTION OF ELECTROMAGNETIC FIELD WITH HIGHER MULTIPOLE MOMENTS IN A PLASMA CLUSTER. V. B. Gil'denburg and I. G. Kondrat'ev (Gor'kii Research Inst. of Radiophysics, USSR). Zh. Tekhn. Fiz., 33: 301-6(Mar. 1963). (In Russian)

Electromagnetic field interactions with small-dimension (in comparison with free space and plasma wavelength) plasma clusters were studied. A universal equation for the force acting upon the cluster was obtained, considering the possibility of resonance-excited high multipole moments. Interactions of plasma clusters with fields of various configuration (axially symmetric, propagating and stationary plane waves) were analyzed. (tr-auth)

24596 GAS FILTER FOR PARTICLE EMISSION CUT OFF. V. I. Kogan. Zh. Tekhn. Fiz., 33: 371-3(Mar. 1963). (In Russian)

A gas filter is suggested for cutting off particle emission in experiments for measuring energy losses in plasma. It is shown that a certain hydrogen thickness can effectively cut off ultraviolet (or soft x-ray) emission of neutral or charged particles with energies not greatly exceeding quantum energies. (R.V.J.)

24597 METHOD OF PRODUCING HIGH GAS TEMPERATURES. Alan C. Kolb (to U. S. Navy). U. S. Patent 3,089,831. May 14, 1963. Filed Aug. 13, 1959.

A device and a method are described for plasma preionizing, preheating, and field trapping for the production of high temperatures in a magnetically confined plasma. The device comprises an evacuated cylindrical chamber, a coil around the chamber, and a first and second capacitor sources for heating and confining the plasma respectively. (D.L.C.)

24598 IONIZATION CHAMBERS OF PLASMA GENERATORS AT HIGH TEMPERATURES. Alain Camille Hadancourt and Jules Cyprien Joseph Poujade (to Societe Nationale d'Etude et de Construction de Moteurs d'Aviation). U. S. Patent 3,089,983. May 14, 1963. Priority date Aug. 11, 1959, France.

An improved ionization chamber is designed for the uniform production of plasma jets at very high temperatures. The chamber comprises a cathode wall, an outlet for the plasma jet, an anode projecting coaxially into the chamber opposite the outlet, means for conducting gas into the chamber, and condenser discharge means for creating voltage impulses between the electrodes. The anode comprises a head portion and a body portion with an internal passage and a nozzle for conducting the gas into the chamber, the exit angle being controlled by the nozzle edge. Several embodiments of the chamber are described. (D.L.C.)

Shielding

24599 (BRL-1190) NEUTRON REFLECTION AND FLUX VERSUS DEPTH FOR NEVADA TEST SITE SOIL. Frank J. Allen, Arnold Futterer, and William Wright (Ballistic Research Labs., Aberdeen Proving Grounds, Md.). Jan. 1963. 255p. (AD-403371)

Detailed calculated results on neutron reflection and flux versus depth for Nevada Test Site soil are given in the form of machine printouts. The angular and energy distributions of the reflected neutrons along with the energy-dependent and total flux at various depths are contained in tabular form on the printouts. Neutron number current, number flux, and dose transmission as functions of thickness are also given in tabular form on the printouts. Tables of summary information on reflection are presented. These contain number current, number flux, dose, and energy reflection factors as functions of incident energy and angle. A few figures are presented to illustrate graphically the meaning of the various tabular results. (auth)

24600 (NAA-SR-Memo-8181) APPLICATION OF THE METHOD OF STEEPEST DESCENT TO LAMINATED SHIELD WEIGHT OPTIMIZATION. R. L. Bernick (Atomic International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 17, 1963. Contract [AT(11-1)-Gen-8]. 7p.

An iterative procedure is described whereby the method of steepest descent may be applied to the problem of laminated shield weight optimization. The treatment is general with no reference made to any particular materials or geometries. (auth)

24601 (WAPD-TM-356) A FORTRAN PROGRAM TO SOLVE THE P-3 GAMMA RAY EQUATIONS IN SLAB GEOMETRY. W. D. Lanning (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1963. Contract AT(11-1)-Gen-14. 41p.

A program was developed to solve the P-3 gamma ray equations in slab geometry. The formulation that is utilized to compute the spatial distribution of the gamma energy flux is described. The program was written specifically as a shield design tool for performing gamma energy deposition calculations and for other potential design applications. (auth)

24602 THE MONTE CARLO METHOD—AN AID IN THE CALCULATION OF RADIATION SHIELDING. F. W. Krueger (VEB EPkA, Berlin). Kernenergie, 6: 89-105 (Mar. 1963). (In German)

Use of the Monte Carlo Method for calculation of radiation transport by finite or heterogeneous shielding is described. Construction of a stochastic comparison process, selection of random samples from arbitrarily distributed whole, and analog and non-analog Monte Carlo calculations for radiation transport processes are discussed. One hundred and eight references are given. (M.C.G.)

Theoretical Physics

Refer also to abstract 22975.

24603 GROUP MOTIONS IN SPACE-TIME AND DOPPLER EFFECTS. J. L. Synge (Dublin Inst. for Advanced Studies). Nature, 198: 679(May 18, 1963).

A space-time which admits a time-like group of motions is considered, and geodesics are drawn for two world lines of a light source and a receiver. The calculation of the Doppler effect is considered for a rotating disk, and a formula is derived: $\nu/\nu' = \{[1-R'^2\omega^2]/[1-R^2\omega^2]\}^{1/2}$, where R, R' = distances of receiver and source from the disk center. (D.L.C.)

24604 CONCERNING THE MATHEMATICAL STRUCTURE AND A CLASS OF RIGOROUS SOLUTIONS FOR THE EXPANDED JORDAN GRAVITATION THEORY. Manfred Truemper (Universität, Freiburg i. B.). Z. Physik, 173: 422-7(1963). (In German)

Exterior solutions of the field equations of Jordan's κ-theory are given. The Bianchi identities are set up and brought into a simple form. All solutions with vanishing conform tensor are determined. There are three classes of solutions characterized by a timelike, spacelike, or lightlike gradient of the gravitational scalar κ. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 23899, 24037, and 24394.

24605 (ACNP-63012) SHAPED BURNABLE POISON DEVELOPMENT PROGRAM UNDER THE EURATOM PROGRAM. Quarterly Progress Report, December 1, 1962–February 28, 1963. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Apr. 10, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-1229. 35p. (EURAEC-628)

Nuclear cross section data for gadolinium, Gd^{155}, and Gd^{157} were compiled. Average absorption cross sections were computed assuming Maxwellian thermal spectra for moderator temperatures from 70 to 600°F. Poison demand curves were computed for a boiling water reactor with an H_2O-to-UO_2 ratio of 2.6, U^{235} enrichments from 1.8 to 3.8 wt %, zirconium or stainless steel as clad, and fuel depletions of 10,000 to 25,000 Mwd/t. Based on the above poison demand curves, poison lumps in the shape of cylinders are being investigated analytically. A calculational method is being developed for detailed depletion studies of cylinders. Gadolinia, alumina, and Al_2O_3–Gd_2O_3 rods were formed and sintered at temperatures to 2700°F, in an air atmosphere for two to six hours. Investigations of reaction between Gd_2O_3 and Al_2O_3 were begun. (auth)

24606 (AEEW-R-136) SANDWICH REACTOR LATTICES AND BLOCH'S THEOREM. R. Alpiar (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1962. 17p.

The study of the neutron flux distribution in repetitive sandwiches of reactor material leads to results analogous to the 1-dimensional form of Bloch's theorem for the electronic structure in crystals. This principle makes it possible to perform analytically accurate homogenizations of sandwich lattices. The method is extended to cover multigroup diffusion and transport theory. (auth)

24607 (AEEW-R-230) A TRANSFER FUNCTION MODEL OF THE BEPO REACTOR FOR CONTROL STUDIES. J. D. Cummins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Sept. 1962. 28p.

A spatially independent (one point) transfer function model of the BEPO reactor is presented. Perturbations in control rod reactivity and coolant flow are considered and transfer functions deduced for variations about four steady states namely zero power, one sixth full power and one sixth full flow, one sixth full power and full flow, and full power and full flow. The transfer functions are presented in pole-zero form. The use of the transfer functions in verifying experimental frequency responses, automatic control studies, and multi-variable non-interacting control design are briefly considered. (auth)

24608 (AEEW-R-231) PERIOD METER OUTPUT DURING STARTUP TRANSIENTS. J. D. Cummins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 1962. 24p.

The time response of a period meter whose input signal comes from an ionization chamber is calculated using a Ferranti Mercury digital computer program. The period meter considered is one for which the input time constant is determined by the input capacity and the logarithmic element. The input excitation is a terminated ramp of reactivity. Other reactivity inputs may be treated. In particular the step change of reactivity may be used as the input excitation. Allowance is taken of the power dependent time constant associated with the logarithmic element and of the differentiating and integrating time constants in the period meter. The program may be used to assess instruments and for safety and operations studies on reactors which use this type of period meter. An example of the use of the program is given. (auth)

24609 (AEEW-R-235(Pt.I)) BRITISH INDUSTRIES COLLABORATIVE EXPONENTIAL PROGRAMME. VOLUME I. INTRODUCTION; EXPONENTIAL EXPERIMENTS ON RODS AND TUBES OF NATURAL URANIUM METAL. (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Windfrith, Dorset, England). Mar. 1963. 264p.

The experimental techniques used in the performance of exponential buckling measurements are described. The results are given on buckling measurements in a wide range of graphite lattices in which the fuel elements consisted of rods or tubes of natural U metal. The observed buckling values are correlated with theory. (auth)

24610 (AEEW-R-235(Pt.II)) BRITISH INDUSTRIES COLLABORATIVE EXPONENTIAL EXPERIMENTS ON ENRICHED URANIUM METAL RODS AND ON CLUSTERS OF URANIUM METAL AND URANIUM OXIDE RODS. (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Mar. 1963. 239p.

Results are given of exponential buckling measurements on graphite lattices containing clusters of U metal rods, clusters of uranium oxide rods, and single U metal rods with a range of near-natural U^{235} contents. In the case of the metal fuel elements the results of the measurements are correlated with theory. (auth)

24611 (AEEW-R-235(Pt.III)) BRITISH INDUSTRIES COLLABORATIVE EXPONENTIAL PROGRAMME. VOLUME III. FINE STRUCTURE EXPERIMENTS; MISCELLANEOUS EXPONENTIAL EXPERIMENTS. (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Mar. 1963. 181p.

Results are given of neutron flux fine structure measurements in graphite lattices containing wide ranges of U metal and uranium oxide fuel element numbers. In the case of the metal fuel elements the observed fine structure parameters are correlated with theory. Measurements of neutron diffusion area in graphite, and of buckling and flux distribution in assemblies containing super lattices of empty channels are included. A correlation with theory of migration area asymmetry measurements in U-graphite lattices is also given. (auth)

24612 (AEEW-R-245) PULSE COUNTING PERIOD METER OUTPUT DURING STARTUP TRANSIENTS. J. D. Cummins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Dec. 1962. 21p.

The time response of a period meter whose input signal

comes from a pulse-counting channel is calculated using a Ferranti Mercury autocode program. The period meter considered is the type for which the logarithmic characteristic is approximated by several diode pump circuits. The input excitation is a terminated ramp of reactivity. Other reactivity inputs may be treated. In particular the step change of reactivity may be used as the input excitation. Allowance is made for the effective time constants of the diode pump circuits and the period meter. The program may be used for instrument assessment and for safety and operations studies on reactors which use this type of period meter. An example of the use of the program is given. (auth)

24613 (BAW-115) OPTIMUM COBALT CONCENTRATION IN THE STEEL OF PRESSURIZED WATER REACTORS. H. Shaw (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Mar. 1960. 40p.

Results of a study to determine the maximum Co concentration that can be tolerated in the stainless steel of pressurized water reactor fuel elements are presented. Active Co is produced by nuclear reactions such as $Ni^{58}(n,p)Co^{58}$ and $Co^{59}(n,\gamma)Co^{60}$. The optimum Co concentration for a 10% Ni steel was found to be 0.05%. Calculation methods for this and similar determinations are outlined. (J.R.D.)

24614 (BMI-X-10038) A STUDY OF ROTARY SHAFT-SEALING CONCEPTS FOR PRESSURIZED-WATER REACTOR APPLICATION. Quarterly Progress Report, January–March 1963. C. Malcolm Allen and Daniel R. Grieser (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 5p. (EURAEC-621)

Studies are being made on the operation and limitations of various concepts of rotary shaft sealing for pressurized-water-reactor applications. The behavior of rotary face seals is being studied by means of an instrumented transparent model that allows direct observation of the fluid in the seal gap during operation. The dual-loop water-supply system was revised to eliminate gas locking, and the construction of the modified system was essentially completed. A graphite stator was fitted with 8 capacitance probes and shakedown runs undertaken to evaluate the operation of the associated electronics that were designed and constructed to permit simultaneous recording on a multichannel oscillograph. Construction of the "inverted" stuffing-box seal experimental apparatus was completed. During the check runs with a single ring of braided, Teflon-impregnated packing, visual observation of the seal interface revealed film rupture at the center of the rubbing area. (M.C.G.)

24615 (BNL-6187) GRAPHITE PROBLEMS IN AIR-COOLED REACTORS. Donald G. Schweitzer (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(20-2)-Gen-16]. 24p.

The problems of oxidation, radiation induced dimensional expansions, and accumulation of stored energy affect long term use of graphite in air-cooled reactors. Results show that frequent low temperature annealing eliminates these problems and may extend the lifetime of the graphite indefinitely. (N.W.R.)

24616 (BNL-6330) CONTROL OF XENON SPATIAL OSCILLATIONS. Gerald S. Lellouche (Brookhaven National Lab., Upton, N. Y.). Aug. 1962. Contract [AT(30-2)-Gen-16]. 23p.

An automatic delayed-reactivity feedback based on exit coolant temperature is shown to lead to an increase in linear stability against xenon oscillations when the delay time is within a few percent of the free period of oscillation. Numerical calculations showed that the stabilizing effect extends into the nonlinear range as well. It is shown that dead-band control is spatially destabilizing if the dead band width is too small. A width of ±5% was, however, found to be sufficient to avoid this form of instability for large changes in power demand. (auth)

24617 (CNLM-1192) FILLING INSTRUCTIONS FOR THE PRATT & WHITNEY FORCED CONVECTION LIQUID METAL INPILE LOOP EXPERIMENT (PW-19). P. T. Heyl (Pratt and Whitney Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Apr. 29, 1959. 36p.

The apparatus and procedures that are to be used to fill the liquid metal system of the Pratt and Whitney Forced Convection Liquid Metal Inpile Loop are described. The liquid metal to be used is a mixture containing 56% Na and 44% K, which is a liquid at room temperature. In order to simplify the filling procedure at the reactor site, two containers, each of which contains exactly enough liquid metal to fill the experiment to the perscribed level, a fill dolly incorporating a purified helium system, and an evacuation system will be provided at the reactor site. After completion of the liquid metal transfer, the liquid metal fill tube will be crimped, cut, and seal welded. The liquid metal and helium systems will then be pressurized through the helium fill tubes, which will also be crimped, cut, and seal welded. Each tube seal weld will be inspected after completion of the weld by mass spectrometry leak check and dye penetrant fault detection. (P.C.H.)

24618 (EUR-238.e) A SIMPLIFIED METHOD FOR ORGANIC, HEAVY WATER LATTICE CALCULATIONS. G. Casini, A. Kind and G. Rossi (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1963. 34p. (EACRP-U-9)

A simplified method to evaluate the neutron balance for organic cooled, heavy water moderated lattices was established at the Reactor Physics Department of Euratom-C.C.R., Ispra (Italy). The method used to calculate the cold unirradiated lattice parameters (Caroline I code for IBM 7090) is based on the French correlation for heavy water cooled and moderated lattices; the replacement of heavy water by organic as coolant is properly taken into account. A test of this calculation method, based on the results of recent Canadian and Euratom critical experiments on natural uranium, organic, heavy water lattices has proved to be satisfactory. No spectral effects are calculated by Caroline I. A complete spatial spectrum determination is given by Termidor, a code written in Fortran language for IBM 7090. By this code the two effects, the hardening due to the absorption in the fuel and the rethermalization due to the interaction of neutrons with the coolant, are separately determined. This approximation seems to give satisfactory results. For hot lattices rethermalization "spectral constants" obtained by Termidor are introduced as input data in Caroline I. The long term reactivity effects are calculated by RLT 2, a code for IBM 650 and 7090. The point reactivity curve is determined by using mainly the AECL proposed data for the 2200 m/sec nuclear cross sections for U and Pu isotopes and fission products constants. The Westcott factors are adopted, and the neutron temperature is calculated by Termidor. The method established for point reactivity calculations has been tested on the experimental Canadian results for rods irradiated in NRX and oscillated in GLEEP; a satisfactory agreement was found. The variation of the reactivity balance following the fuel movement assumed in the power reactor design is also calculated by RLT 2. The method is based on

the perturbation theory. Steady state conditions are supposed. The following types of fuel movements have been considered up to now in the code: homogenized fuel model, single rod fueling, 2 slug bi-directional fueling, continuous bi-direction fueling. According to the above method, a complete calculation of the lattice parameters including the long-term reactivity curve for a given fuel movement takes 1 minute of IBM 7090. (auth)

24619 (EACRP-U-10) DEVELOPMENT PROGRAMME FOR D_2O LATTICE REACTIVITY CALCULATIONS. G. Casini, A. Kind, and G. Rossi (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1963. 11p. (EUR-239.e)

The development of simplified methods which do not need high computation times but treat the essential points in a correct physical way is discussed for reactivity evaluations of heavy water lattice calculations. The main problems are an improvement in the determination of the p factor and a correct description of the space dependent neutron spectrum in the lattice. Both points are of particular importance for lattices with fuel element bundles of great dimensions and containing moderating coolant. (N.W.R.)

24620 (EACRP-U-12) REMARKS ON THE PHYSICS OF HEAVY WATER LATTICES. B. I. Spinrad and R. W. Meier (European-American Committee on Reactor Physics). Feb. 1963. 13p.

Gathering and disseminating information on D_2O lattices, integral parameters required to specify heavy water lattice performance, status of the method used for D_2O lattice calculations, data needed for the operating conditions of reactors, use of the substitution method to study lattice buckling with interpretation of the results by the one-group perturbation or the two-group two-region method, experiments to get information on burn-up in D_2O lattices, and determination of neutron spectra and cross sections relevant to burn-up studies are examined. (D.C.W.)

24621 (EUR-281.e) REACTIVITY EFFECTS DUE TO VARIATIONS IN NUCLEAR PARAMETERS IN A THERMAL POWER REACTOR. G. Casini and M. Paillon (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1963. 21p.

The influence on the neutron balance of small variations of some nuclear parameters in a natural uranium power reactor was investigated. The most important nuclear cross-section influences were found to be due to uranium-235 and plutonium-239. A variation of 1% in the fission cross-section of plutonium-239 gives a variation of about 0.6% on the reactivity for an ORGEL type reactor. As far as the lattice parameters were concerned, the calculations confirmed the necessity to improve the accuracy of the activation experiments, in particular for resonance escape probability determination, in order to have results comparable with criticality measurements. (auth)

24622 (EURAEC-540) HEAT TRANSFER AND STABILITY STUDIES IN BOILING WATER REACTORS. Quarterly Progress Report VIII, October 1, 1962 to January 1, 1963. (Eindhoven, Netherlands. Technische Hogeschool). Jan. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 032-60-11-RDH. 63p.

The operation of the pressurized boiling loop was improved by installing an automatic pressure control. Installation of Inconel-sheathed thermocuples calibrated at 43 to 225°C is reported. Progress was made in developing the instrumentation for the measurements in non-steady states. The measurement of the anode current of a photomultiplier, in use in the radioactive method for void fraction measurement, was developed in a small air-water loop. Preparations are being made for use of this method in the pressurized loop. Calibrations were carried out with the capacitance method using the static void column. The measurement showed a good reproducibility. The onset of plug flow could be observed. The technique for measuring the transfer functions from power to the dependent variables as void fraction and flow rate was further established. Burnout and hydraulic stability experiments were carried out at saturation temperatures of 230, 200, 180, and 140°C with a 7-rod bundle test section using the hot patch technique. In these series the subcooling was varied. Burnout did not occur at 230°C at a channel power of 600 kw with 14 and 40 kw subcooling, when the uniform heat flux was 133 w/cm^2, the highest heat flux in the patch 292 w/cm^2 and exit quality about 20%, but it did at 550 kw, when the subcooling was increased to 94 kw. The oscillations in inlet velocity were recorded. The transition from noise to periodic flow oscillations occurred approximately in the following conditions: 230°C, 600 kw, 200°C, 500 kw, 180°C, 450 kw and 140°C, 325 kw. The effect of exit construction was to make the system less hydraulically stable. Trip occurred during a period of divergent periodic velocity oscillations. A steady state and hydraulic instability program with a single rod annulus geometry is under way. Experiments were carried out at 120, 160, 200, and 230°C saturation temperatures. Going from 150 kw to 160 kw at 160°C, the amplitude of the flow oscillations increased by a factor of 5. The period of these oscillations was about 0.9 seconds. Increasing the power from 160 kw to 200 kw, gave only a slight further increase in amplitude. Subcooling increased considerably the period of the oscillations. At 200°C these oscillations started at about 200 kw and at 230°C at 330 kw. Before the onset of the oscillations, small fluctuations in saturation temperature could be observed with a period of 20 seconds and an amplitude of a few degrees C. The program will be continued with void fraction and flow rate measurements and observing the signals from these quantities. A digital computer program was made for calculating the recirculation rate in test loops. In this program subcooled boiling is incorporated. The model was designed in such a way, that different heat flux distributions and geometries and correlations for the expansion loss, acceleration loss, slip factor, two-phase friction loss and entrance loss, can easily be substituted. The testing of the program was finished. A systematic analysis will now be carried out. The general flow equations were formulated for the insteady case, starting from fundamental fluid dynamics. Much emphasis was placed upon the correct representation of the increased heat transfer and frictional pressure drop under boiling conditions. Similarity parameters were derived which govern the solution of the exact equations. The steady state case was considered in more detail. A correlation and criterion could be derived for the increased frictional pressure drop respectively the occurrence of burnout. A comparison of quantitative data derived from the theory with experimental results will be made. A description of the loop behavior is now under way, starting from the geometry and operating conditions of the present loop. This will be programed for an analog and a digital computer. (auth)

24623 (GA-2318) A PROCESS FOR MAKING GRAPHITE LESS PERMEABLE TO GASES AT HIGH TEMPERATURES. G. R. Tully Jr., and B. F. Disselhorst (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 1, 1963. Contract AT(04-3)-314.

A process for treating commercial graphite to lower its permeability to the order of 1×10^{-5} cm^2/sec by a series of impregnations with a furfuryl alcohol type of monomer is described. Graphites with maximum pore diameters up to 40 μ, as measured by mercury porosimetry, can be treated. The impregnant is heated to >2650°C in the process, so the treated material is suitable for high-temperature applications, as in the core of a nuclear reactor. Details of the experimental procedure and equipment and the effect of the process on the properties of the graphite are given. Tubes of HLM-85 graphite, 4 ft long and 3½ in. in outside diameter with a wall thickness of ⅜ in., were treated to permeabilities of $<1 \times 10^{-5}$ cm^2/sec by the process. (auth)

24624 (GEAP-3923) RESONANCE INTEGRAL CALCULATIONS FOR EVALUATION OF DOPPLER COEFFICIENTS — THE RAPTURE CODE. J. H. Ferziger, P. Greebler, M. D. Kelley, and J. W. Walton (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 12, 1962. Contract AT(04-3)-189. 39p.

A code (RAPTURE) was programmed for the Philco TRANSAC 2000 computer to perform calculations needed for the evaluation of doppler coefficients in fast reactors with degraded neutron spectra. This code computes resonance integrals, averages them over resonance parameter distributions, and computes fission and capture cross sections as a function of fuel temperature and of potential scattering cross section per absorber isotope. The cross sections are computed at specified values of neutron energy for the unresolved resonance region; and they are computed separately for each angular momentum state (l,J) of a given compound nucleus. For the resolved resonance region of a given isotope, fission and capture cross sections are flux-averaged over a specified energy interval. The calculations done by the code are strictly valid only for the energy range in which resonances are well separated (≤1 kev for U-235 and Pu-239; ≤10 kev for U-238). At higher energies, the Code may be used for Doppler calculations with a relatively small correction of the output required for resonance overlap. (auth)

24625 (GEAP-3981) SODIUM-COOLED REACTORS PROGRAM. FAST CERAMIC REACTOR DEVELOPMENT PROGRAM. Third Quarterly Report, April–June 1962. F. J. Leitz, ed. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189. 117p.

The progress made in the development of the Fast Ceramic Reactor is reported. Results are given of the experiments performed in the Fast Reactivity Excursion Device. Information is also reported on vented fuel development, fuel testing in TREAT, fuel fabrication development, fast-flux fuel irradiations, and reactor dynamics and design. (N.W.R.)

24626 (GEMP-76) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 76. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 29, 1963. Contract AT(40-1)-2847. 47p.

The status of the work in progress on reactor instrumentation and control developments is reported. A wafer-type drive rod for use with a modified electromagnetic unit was designed, fabricated, and preliminarily tested. A ball-counter circuit was developed and tested. A control for use with an electromagnetic unit was further developed under static switching. A control system for the linear-induction motor used in the circulating-ball reactivity control program was constructed, and a modified five-channel scram bus with improved trip indication was constructed. Other work included the fabrication and testing of a ceramic coated temperature sensor, extension of applications experiments to include control of a furnace by wireless transmission of temperature, and the investigation of several electrical effects pertinent to the program. Testing of fission counters and fission counter components to 1500°F, d-c ionization chambers to 1000°F, and ionization chamber components to 1200°F was continued. Two 1000°F gridded ionization chambers were constructed and initial tests were performed. A charged-fragment neutron detector containing a grid structure for capturing secondary electrons was designed and is being constructed. (N.W.R.)

24627 (HW-63328) EFFECT OF THE PRTR FUEL ELEMENT RUPTURE TEST FACILITY ON PLUTONIUM RECYCLE PROGRAM OBJECTIVES. R. E. Peterson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 29, 1960. Contract AT(45-1)-1350. 10p.

An evaluation was made of the PRTR fuel element rupture test loop. The effects studied were reactivity of the PRTR, program schedules, physics analysis and data, and reactor startup. It was found that no additional enrichment is required to support this loop beyond that already provided in shim control allowance for small variations in reactivity. The loop was designed for automatic operation with safety tie-ins to the reactor control circuit as required. A thorough safety analysis of the loop is being carried out. (M.C.G.)

24628 (HW-SA-2946) NUCLEAR REACTOR INSTRUMENTATION SYSTEMS FOR THE NEW PRODUCTION REACTOR. G. L. Swezea (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 11, 1963. Contract AT(45-1)-1350. 16p.

Operation of a nuclear reactor of the NPR type and size is shown to require systems with considerable multiplicity which must exhibit a high degree of integrity, reliability, accuracy, and a high degree of failsafe performance. A continuous program of reactor instrumentation improvement resulted in significant improvements being made available for use in the nuclear instrumentation systems for the New Production Reactor. (auth)

24629 (HW-SA-2981) BASIS OF DESIGN — HANFORD NEW PRODUCTION REACTOR (NPR). W. J. Dowis (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 19, 1963. Contract AT(45-1)-1350. 17p.

The design of the Hanford New Production Reactor (NPR) is discussed. The reactor plant was designed to operate originally as a plutonium production plant. Provisions were made for extension of the facilities to produce by-product steam suitable for the generation of electric power while still producing plutonium as the principal product. Provision was also made for conversion to power-only operation in the event that the need for plutonium should diminish or terminate. Plans call for operation in first phase for one year and then conversion to second phase with both plutonium and steam being produced. Economic aspects of the reactor are discussed. (M.C.G.)

24630 (IDO-11004) ORGANIC COOLANT ESSENTIAL DATA. Annual Report, January 1–December 31, 1962. J. A. Ellard, C. D. King, M. V. Milnes, W. H. Hedley, W. J. Moodie, and W. H. Yanko (Monsanto Research Corp. Dayton Labs., Ohio). Jan. 31, 1963. Contract AT(10-1)-1088. 125p.

The objectives of the Organic Coolant Essential Data program are: to measure, confirm, and compile thermodynamic, physical, and heat transfer data of biphenyl; and to establish experimental methods, techniques, and

correlation methods for fundamental data on the isomeric terphenyls and other selected organic coolants. PVT measurements on biphenyl were completed, and a Benedict-Webb-Rubin equation of state was fitted to the data. This equation was used in conjunction with the spectroscopic heat capacity data of Katon and Lippincott to calculate the thermodynamic properties of biphenyl liquid and vapor from 160 to 1000°F. Biphenyl critical properties calculated from the equation of state were in good agreement with the measured values. Biphenyl thermodynamic properties were used to calculate theoretical power efficiencies obtainable in turbines operated with dry saturated biphenyl vapor at 200 to 400 psia inlet and 0.25 and 1 psia outlet pressures. An isothermal drop calorimeter was designed and built to test the calculated network by direct measurement of the liquid heat capacity. Heat content measurements were made on the Pt-20% Rh sample container, quartz capsules, and diphenyl ether. Equations were derived for the specific heats of these materials. These measurements proved that the high capacity calorimeter has a precision of 0.2% or better and an absolute error of less than 1%. Purification methods for the isomeric terphenyls were defined and pure samples prepared. The viscosity and thermal conductivity of the three terphenyls were measured in the liquid phase and calculation methods established for the low pressure vapor and saturated vapor phases. Methods for calculating these properties were also defined for the vapor phase of biphenyl. From derived equations applied to an IBM-704 computer program the viscosity and thermal conductivity data in both the liquid and vapor phases were summarized in tabular form at 10°F intervals from the melting point up to at least 850°F for biphenyl and the three terphenyls. A total of 78 biphenyl heat transfer runs were made in the test loop under various circulating conditions: forced circulation without boiling, forced circulation with surface boiling, forced circulation with bulk boiling, and thermosiphon (natural circulation with bulk boiling). Other operating conditions were: temperature of 413 to 783°F; pressure of 41 to 210 psig; flow rate of 1030 to 11,250 lb/hr; and heat flux of 12,700 to 108,300 Btu/hrxft^2. Data obtained under nonboiling conditions was correlated, with an average deviation of 6.3%, by the derived Dittus-Boelter type equation: $Nu = 0.0166\ (Re)^{0.84}\ (Pr)^{0.39}$. Insufficient data were accumulated under boiling conditions for a satisfactory correlation. A 250-hr run, made to measure deposition on, and corrosion and erosion of, various metal alloys exposed to hot biphenyl vapor at 700 to 710°F and vapor velocity of 7 and 200 ft/sec, gave no significant corrosion or erosion. There was some deposition on the specimens. A main heat transfer tube (Model III) was constructed. Electrical geometrical analog studies were made of wall temperature gradients in the main heat transfer tube in order to properly evaluate the validity of inside surface temperatures indicated by thermocouples brazed into the tube wall. A batch distillation unit was set up capable of purifying 10 lb/hr of contaminated biphenyl. (auth)

24631 (IDO-16833(Rev.1)) FEASIBILITY AND CONCEPTUAL DESIGN FOR THE STEP LOSS OF COOLANT FACILITY. T. R. Wilson, O. M. Hauge, and G. B. Matheney (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 24, 1963. Contract AT(10-1)-205. 184p.

A summary of studies conducted on the pressurized-water reactor loss-of-coolant accident is presented, and an experimental safety program is proposed. The various phenomena involved in the loss-of-coolant accident, related research and development programs, assumptions currently used to predict the various physical phenomena, and the general approach to be used in conducting the safety tests are discussed. In order to accomplish the loss-of-coolant experimental safety program, a dry containment test facility is proposed for construction at the Test Area North of the National Reactor Testing Station in Idaho. The site selection utilizes existing support facilities suited for performing nuclear safety tests requiring experiment assembly areas and post-test analytical examination of the irradiated nuclear components. (auth)

24632 (IDO-16853) RECLAMATION OF DAMAGED NUCLEAR REACTOR COOLANT BY CATALYTIC HYDROCRACKING. L. E. Gardner (Phillips Petroleum Co. Research and Development Dept., Bartlesville, Okla.). Mar. 29, 1963. Contract AT(10-1)-1080. 60p.

Catalytic hydrocracking has reconverted into usable coolant the high boiling radiolytic products produced terphenyls in OMRE. Using a cobalt molybdate on low surface area alumina at a 25% conversion level with recycle of the unconverted residue, liquid product recovery was 98% with an ultimate yield in the coolant boiling range of 80%. Operating temperatures of 850–950°F, pressures of 500–1000 psig, and flow rates of 0.5 to 2.0 LHSV were used, with 0.5 to 2.5 SCFH of hydrogen. The most satisfactory catalysts were cobalt molybdate, cobalt oxide + vanadia, platinum, and a low metal content nickel, all on low surface area alumina. Coke deposition rate was less than 0.20%/hr, and the catalysts were easily and repeatedly regenerated. The unconverted residue in the product was no more refractory than the virgin feed and could be recycled substantially to extinction. Coolant reclaimed had molecular weights of 210 to 230 and contained some biphenyl, triphenylene, and alkylpolyphenyls as well as the desired terphenyls. The products had good thermal stability up to 750°F, and were stable to electron irradiation at 650°F up to 10^9–10^{10} rads. In a hydrocracking unit scaled to handle the estimated high boiler production of 50,000 lb/d from a 300 Mwe/d power plant, total manufacturing costs are estimated at $0.053/lb compared to the present delivered price of $0.17/lb for fresh terphenyl coolant. (auth)

24633 (LA-2858) INTEGRAL NEUTRON AND GAMMA DOSE MEASUREMENTS ON THE KIWI B-1 REACTORS. PART I. KIWI B-1A. PART II. KIWI B-1B. F. C. V. Worman, P. K. Lee, R. W. Henderson, and F. M. Cox (Los Alamos Scientific Lab., N. Mex.). Mar. 1963. Contract W-7405-eng-36. 83p.

An evaluation of the direct radiations from the Kiwi B-1 reactors is presented. Included are integral measurements of gamma dose, neutron flux and neutron dose, made on Experimental Plans 4, 5, 5A, and 6 + 6A of Kiwi B-1A, and Experimental Plans 2, 3, and 4 of Kiwi B-1B. Results were obtained from almost every instrumented station. Gamma doses, in air, on Experimental Plan 6 + 6A ranged from 1.80×10^4 rads at 62 ft to <10 rads at 1,500 ft. Neutron doses, in air, varied from 5.51×10^5 rads on the privy roof to 2.30 rads at 1,500 ft. Thermal neutron fluxes dropped from 165% of the total fast neutron flux, at close proximity to the reactor, to 80% at 300 ft and 60% at 600 ft. Documentation of the radiation field, in close proximity to the Kiwi B-1A reactor, was accomplished for several studies including an experiment in cooperation with Brookhaven National Laboratory, a meridian ring experiment, and a determination of the shielding qualities of the privy roof. For Experimental Plan 4, Kiwi B-1B, gamma doses, in air, ranged from 4.85×10^4 rads at 62 ft to 7.50×10^1 rads at 900 ft. Fast neutron doses, in air, ranged from

1.37×10^4 at 62 ft to 1.32×10^2 at 600 ft. Thermal neutron fluxes dropped from 192% of the total fast neutron flux at 62 ft to 49% at 600 ft. (auth)

24634 (NAA-SR-Memo-4757) ANALYSIS OF RADIATION FROM HNPF COLD TRAPS AND PRIMARY SODIUM PUMPS DURING REMOVAL AND SHIPPING. W. A. Rhoades (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 15, 1959. Contract [AT(11-1)-gen-8]. 14p.

The expected maximum contamination of the HNPF cold traps and primary sodium pumps was determined along with the maximum dose rates from these components during removal and shipping. Suitable shielding for casks to be used in the removal operation and for shipping these components away from the reactor site is specified. Access to an unshielded cold trap is limited by high dose rates, i.e., 100 mr/hr at 120 ft, after 180 days decay time. A handling cask providing a radial shield of 3 in. of lead will provide adequate personnel protection for the removal operation, if 180 days decay time is allowed before the trap is removed. An additional 2.4 in. of lead is required for off-site shipment of the cask. This additional shielding can be added after the trap is removed from the reactor building. Dose rates from the cold trap after the shield plug is removed from the access hole are shown. If direct line-of-sight exposure is avoided, dose rates to personnel will be below 100 mr/hr at any position, and below 10 mr/hr at distances greater than 20 ft from the access hole. Dose rates from the cask during its travel away from the hole, will be below 100 mr/hr at distances from the cask greater than 10 ft and below 10 mr/hr at 35 ft, if the cask is raised no more than 3 in. from the floor during its travel. Remote, unshielded handling of a primary sodium pump is feasible, since dose rates would be 100 mr/hr at 28 ft and 10 mr/hr at 90 ft, after ten years of operation, and providing that 14 days decay time is allowed to eliminate activity from the Na^{24} film clinging to the pump. Dose rates after only one year of operation would be lower by a factor of 4. The cold trap handling cask can also be used for sodium pump removal. Additional shielding of 1 in. of lead is required for off-site shipment of the pump. Dose rates from the cask during pump handling will be well below those during handling of the cold trap, and thus will present no serious difficulty. (auth)

24635 (WAPD-BT-28) BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1963. Contract AT(11-1)-Gen-14 and appropriate NObs- contracts. 80p.

Separate abstracts were prepared for five of the six papers included. One paper, on space and time synthesis by the variational method, was previously abstracted in NSA. (D.C.W.)

24636 (WAPD-BT-28(p.1-20)) A NUMERICAL METHOD FOR THE DETERMINATION OF THE EFFECT OF PLANT CHARACTERISTICS ON CORE POWER TILT. J. V. Reihing, Jr. and J. E. Funk (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

A numerical method for the determination of the effect of nuclear reactor plant characteristics on reactor core power distribution is described. This technique can be used, for example, to investigate the effect of steam generator heat removal capabilities upon core power tilt. In addition to a list of plant characteristics, the method assumes a knowledge of total reactor core power, the distribution of core power in terms of the deviations of the average temperatures of the core quadrants from the overall core average temperature, and the flow and energy redistributions that occur in the reactor inlet and exit plenums. The method is cast in matrix notation and a computational procedure for the solution of the set of matrix equations is suggested. (auth)

24637 (WAPD-BT-28(p.21-6)) USE OF GADOLINIUM SEPTA IN SLAB CORES. J. J. Kepes and J. A. Mitchell (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). (WAPD-T-1451)

The nuclear characteristics of gadolinium in septa form were predicted and compared to experiment in three critical assemblies. These cores were designed to provide different spectral environments for sheets of 4.3 wt % gadolinium in zirconium. Two diffusion theory models were examined. A variational method predicted the k_{eff} to within +0.3% and −1.4%, whereas an iterative treatment was 1% to 2% low. (auth)

24638 (WAPD-BT-28(p.45-52)) THE DETERMINATION OF THE DENSITY OF CERAMIC FUEL WAFERS BY RADIATION METHODS. H. H. Lang (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Measuring the thickness of a material and the attenuation of a collimated beam of radiation passing through the material provides a method of rapidly determining its density. Gages based upon this principle were developed and used to determine the density of PWR Core 2 seed and blanket wafers. An inspection rate of one wafer a minute was achieved. For the blanket wafers, the precision of the gage method is greater than that of the wet density method; for the seed wafers, it is equivalent. (auth)

24639 (WAPD-BT-28(p.53-9)) THE THERMAL STABILITY OF TEFLON AND ITS COMPATIBILITY WITH AUSTENITIC STAINLESS STEEL AND OTHER STRUCTURAL MATERIALS. R. E. Moore (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

An investigation was made of Teflon in contact with austenitic stainless steels and with other structural materials. Teflon displayed excellent thermal stability in aerated water at 400 to 550°F and above, and no stress corrosion cracking of stressed samples was observed after 28 days in 535°F aerated, deionized water (pH 10). It is concluded that Teflon can be safely used under conditions up to 535°F in aerated or in nonaerated high-purity water. Teflon is compatible with structural alloys in aerated water even up to 636°F, but is subject to cold flow at these conditions. (auth)

24640 (WAPD-BT-28(p.61-75)) A VERIFICATION OF METHODS FOR ANALYZING STRESSES AND DEFLECTIONS IN PERFORATED MATERIALS AND AN EVALUATION OF ROLLED-IN TUBE EFFECTS. W. J. O'Donnell (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

A perforated steel beam with a triangular penetration pattern was subjected to uniaxial tension, compression and bending loads. Measured deflections and ligament strains agreed very satisfactorily with results calculated using recently developed analytical methods. Beams with rolled-in tubes were also tested, and the calculated results agreed with the measured results when one half of the tube wall was assumed to act as an integral part of the perforated material. (auth)

24641 (WCAP-1700) ION-EXCHANGE WITH EQUILIBRIUM AND DECAY. P. Cohen and G. R. Taylor (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Jan. 1961. Contract AT(30-1)-3064. 19p.

A mathematical analysis of the efficiency of an ion-exchange resin column in removing radionuclides of moderate half life, assuming mass transfer from the liquid to the resin surface is the rate controlling step, is presented. The steady-state results are illustrated for a typical reactor purification system. (auth)

24642 (WCAP-3714) REACTOR CONTROL AND PROTECTION SYSTEM STUDY FOR CHEMICAL SHIM OPERATION OF A LARGE CLOSED CYCLE WATER REACTOR. J. S. Moore and B. H. Axelson (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Oct. 1962. Contract AT(30-1)-3064. 72p.

Work that formed the basis for the functional design of a reactor control and protection system for a large closed-cycle water reactor is described. Operation with chemical shim and nominal rated power of 825 Mw(t) was specified throughout the study. In the protection system study, emphasis was placed on the reactivity insertion accident at power. The control system study emphasized the step load transient. These two transients placed the most severe requirements on their respective automatic systems and consequently yielded the majority of the functional design requirements for these two systems. The control and protection system evolved from this study meets normal transient load requirements and the protection requirements with a minimum chance of unwanted reactor scrams. (auth)

24643 (AEC-tr-5704) RESEARCH PROGRAM OF THE MONTECUCCOLINO GROUP. B. Ferretti and F. Pierantoni. Translated for Los Alamos Scientific Lab., N. Mex. from a publication of the Comitato Nazionale per l'Energie Nucleare, Rome, 1960. 6p.

The research programs of the Montecuccolino Research Group concerning reactor design, neutron theory of reactors, and fuel cycles are discussed. The experimental facilities available to the Group are discussed. (N.W.R.)

24644 (EURAEC-512) THE OUT-OF-PILE PART OF A MEDICIS LOOP TO BE INSTALLED IN THE CENTRE D'ETUDES NUCLEAIRES MELUSINE REACTOR AT GRENOBLE. VOLUME I. OPERATIONAL PROCEDURE — OUT-OF-PILE PART. Special Report No. 4. (Brussels. Societe d'Etudes, de Recherches et d'Applications pour l'Industrie). [nd]. Includes VOLUME II. DRAWINGS. Work Performed under United States–Euratom Joint Research and Development Program. 109p. A translation.

The Medicis loop installed in the Melusine reactor of the Centre d'Etudes Nucleaires de Grenoble to study the continuous diffusion of fission gas under isothermal conditions is described. Experiments carried out with the equipment are outlined. (C.H.)

24645 (EURAEC-565) HYDRODYNAMIC INSTABILITIES LIMITING THE POWER OF BOILING WATER REACTORS. Quarterly Report No. 3, September 15 to December 15, 1962. (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). Jan. 15, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 076-61-12-RDF. 30p. A translation.

The boundaries of instability on boiling loop CF4 are given under the following conditions: vertical channel, upward flow; circular section, 6 mm; heating walls in aluminium A4, thickness 1 mm; heating length, 1.16 m; height of riser, 2.45 m × ϕ 6 mm; forced convection with bypass; friction pressure loss at the inlet; length of external inertia; 0.75 m of channel, specific power, from 50 to 200 w/cu. cm; and piezometric load between 1.25 and 10 m, with head of cold water, in addition to the hydrostatic load. The quality of the emulsion at the outlet of the heating channel, corresponding to the appearance of instability, was between 0 and 5%. (auth)

24646 SOME ASPECTS OF THE APPLICATION OF A TWO-DIMENSIONAL AND TWO-GROUP DIFFUSION PROGRAM. Ya. V. Shevelev and V. K. Saul'ev. At. Energ. (USSR)., 14: 200-5(Feb. 1963). (In Russian)

During the years 1957-58 a program for solving reactor equations was initiated to determine the effective neutron multiplication coefficient k_e and the thermal and fast neutron fluxes, i.e., the eigenfunctions Φ_1 and Φ_2. By means of this relatively simple program it was found possible to solve a wide variety of reactor problems without changing the code. The program is based on the assumption of a regular, cylindrical region. Difficulties arise when the reactor parameters in the first approximation agree with the mathematical scheme used but still contain some contradictory elements. The inadequacies of the two-dimensional geometry and of the two-group equations are pointed out. The program may be used for calculating temperature fields in bodies with complex, two-dimensional geometry. Examples are presented giving the limits of applicability of the method. (TTT)

24647 THE KAHL RESEARCH LOOP FOR NUCLEAR STEAM SUPERHEATING. Roland Kuehnel (Verfasser ist Mitarbeiter der AEG, Abteilung Kernenergieanlagen, Frankfurt am Main). At. Strom, 9: 9-10(Feb.-Mar. 1963). (In German)

In the development of a hot steam reactor, the design, manufacture, and testing of operational fuel elements for the production of super-heated steam is a major nuclear problem. The design and operation of a loop to study this problem is given. The irradiation program for tubular fuel elements is outlined. (J.S.R.)

24648 COMPARISON OF TWO- AND THREE-GROUP CALCULATIONS WITH MEASURED VALUES. H. G. Fendler, G. Knoerzer, and H. Preusch. Atomkernenergie, 8: 137-42(Apr. 1963). (In German)

Shielding calculations, which were carried out with a two-group program and with a three group one, both for fission, epithermal, and thermal neutrons are presented. For the γ radiation a distribution in 10 energy groups was used. The calculations concern the shielding in the upwards axial direction of the Boiling Water Reactor KAHL, whose top consists of iron plates. The comparison of the measured values with the calculated ones shows that the calculations are correct only if a material containing hydrogen is put between the iron plates. (auth)

24649 THE TASKS OF A REACTOR DEPARTMENT. G. Locke (Abteilung Kernenergie-Anlagen der AEG, Frankfurt am Main). Atompraxis, 9: 136-9(Apr. 1963). (In German)

Various stages from the design of a nuclear reactor to the advanced stage shortly prior to commencing construction are described in brief. Subsequently, the groups of experts and their specific fields of activity are discussed, which are required for the performance of these tasks in the scope of this project. An outlook is presented on the erection and commissioning of the reactor plant. (auth)

24650 THE DEVELOPMENT OF NUCLEAR TECHNOLOGY IN SWITZERLAND. U. Hochstrasser (Atompraxis, 9: 150-3(Apr. 1963). (In German)

In the coming decade Switzerland must find a new source of energy to meet its electricity needs. In view of conditions in Switzerland, atomic energy is one of the most

promising sources. In addition, the Swiss machine, electric, and equipment industry is greatly interested in reactor development as a new potential export area. Reactor development in Switzerland began several years ago. The plans and projects which were laid out during this period are now being put into practice in the construction of the experimental power plant in Lucens. Both the government and private industry have spent considerable sums of money for building the research facilities necessary for reactor development, especially the Federal Institute for Reactor Research in Würenlingen. Swiss efforts in this direction have been greatly aided by international cooperation, in which Switzerland actively participates. However, an even greater effort will be required if the work done hitherto is to come to fruition. Certain indications are given on the possibility of extending the presently realized concept of a heavy-water-moderated, gas-cooled pressure-tube reactor, and the goals of Swiss work in this field are discussed. (auth)

24651 METHODS OF MAKING CONCRETE BLOCKS FOR THE SHIELDING WALLS OF BUILDINGS HOUSING NUCLEAR REACTORS AND ACCELERATORS. L. N. Zaytsev. Beton i Zhelezobeton, No. 5, 227-30(1962).

A reactor shielding wall was made of precast concrete blocks, measuring 1.855 × 1.785 × 1.850 m and weighing 13.6 tons, which were placed on a heavy solution mortar, forming a 1-cm-thick seam. The seam density checked with a gamma installation was satisfactory. For experimental purposes type 100 concrete was used for making 2 × 1 × 1-m blocks, weighing 4.6 tons with their lateral sides shaped in the form of keys and keyways. The vertical seams had a shielding ability equal to that of the horizontal seams. The shielding equivalency of walls made of precast concrete blocks and of monolithic concrete was confirmed by physical calculations. A description is given of the process of manufacturing the precast blocks using a box formwork method in which diaphragms are used for shaping the lateral sides of the blocks. The system has important technical and economical advantages. (TCO)

24652 HEAT TRANSFER IN WATER COOLED NUCLEAR REACTORS. J. Randles (United Kingdom Atomic Energy Establishment, Winfrith, Eng.). Chem. Process Eng., 44: 243-7(May 1963).

A theoretical study of heat transfer in water-cooled reactors is given in two parts, the first of which deals with steady-state heat transfer and the second with nonequilibrium conditions. In the part dealing with the steady state, the problem solved is that of a fuel rod situated in a neutron flux which changes appreciably over the diameter of the rod. This gives rise to a larger power output on one side of the fuel element than on the other and consequently a larger heat flux to the coolant on one side than the other. In the second part dealing with nonequilibrium conditions, the theory is extended to include the effect of a time-dependent fission power. It is shown that the fission power and heat flux to the coolant can be inter-related by means of a simple set of time-dependent, first-order differential equations. (auth)

24653 CALCULATIONS OF FIRST-COLLISION PROBABILITIES FOR HETEROGENEOUS LATTICE CELLS COMPOSED OF n MEDIA. F. Di Pasquantonio (Trentina di Elettricità S.p.A., Milan). J. Nucl. Energy, Pts. A and B, 17: 67-81(Feb. 1963).

A general and rigorous method is developed for the calculation of first-collision probabilities for a cell made up with n different media. The chief advantage of the method is that of allowing the immediate writing of analytical expressions of first-collision probabilities for cells composed with any number of media. The equations are used for writing analytical expressions of first-collision probabilities for three particular cells containing holes. The formulas for the effective calculation of first-collision probabilities for the first of cells are carried out, on the hypothesis of cylindrical geometry with revolution symmetry. The equations obtained are then used to calculate first-collision probabilities for hollow natural uranium cylinders and diffusion coefficients for the cell. The numerical results obtained are compared with those determined by others or with those obtained by homogenization. (auth)

24654 LAYER REACTOR ACCORDING TO THE TWO-GROUP THEORY. G. Bessner, W. Macke, and Chr. Reiche. Kernenergie, 6: 113-16(Mar. 1963). (In German)

The neutron distribution in a finite-layer reactor with thin fuel layers was calculated according to the two-group theory. A comparison of critical conditions permitted the determination of group constants for the homogeneous reactor. (tr-auth)

24655 PURIFICATION OF A REACTOR CIRCUIT FROM CORROSION PRODUCTS. G. G. Andronov and N. K. Komarova. Korroziya Reaktornykh Materialov, Sb. Statei, 277-82(1960).

A solution is recommended for washing the cooling system of a reactor made of Al alloy, which has the composition: CrO_3 20 g/l, H_3PO_4 35 ml/l (specif. weight 1.68); temperature ~20°C; duration of treatment: until corrosion products are completely dissolved. The etching solution is removed from the whole reactor (tank and cooling system) by repeated and careful washing with distilled water. Washing with 8% HNO_3 solution is not recommended because intercrystalline corrosion might occur in the junction zone. (Referativnyy zhurnal, Khimiya, No. 20, 1961)

24656 MEASUREMENT OF THE MULTIPLICATION FACTOR k_∞ OF A WATER–UO_2 REACTOR LATTICE. Gerhard Riesch (AEG-Kernenergieversuchsanlage, Grosswelzheim, Ger.). Nukleonik, 5: 104-10(Apr. 1963). (In German)

The multiplication factor for light-water lattices was determined with a zero-reactivity measurement. By mixing B_2O_3 with the moderator water, k_∞ of the lattice was made equal to one, which was determined with the help of a test reactor. The reactivity change of the reactor had to be zero if the exactly poisoned insertion was exchanged for air in a place in the reactor in which the flux gradients of all examined neutron groups were zero. This condition was produced by surrounding the measurement insertion in the reactor with an adapter. For the apparatus used a measurement accuracy of ±1% for k_∞ could be calculated. (tr-auth)

24657 FAST FISSION IN LIGHT-WATER-MODERATED LATTICES. Andrej Sauer (Allgemeine Elektricitats-Gesellschaft, Frankfurt am Main). Nukleonik, 5: 110-15 (Apr. 1963). (In German)

From the results of measurements of the ratios of the fission rates of U^{238} and U^{235} in light-water-moderated critical assemblies with slightly enriched fuel, effective cross sections were derived, with whose help the fast fission factor in power reactors could be calculated. (tr-auth)

24658 THE INFLUENCE OF LARGE CAVITIES ON THE NEUTRON DISTRIBUTION AND REACTIVITY IN NUCLEAR REACTORS. D. Emendoerfer (Technische Hochschule, Stuttgart). Nukleonik, 5: 115-20(Apr. 1963). (In German)

In connection with a derivation of boundary conditions, the neutron distribution and reactivity in nuclear reactors

with large cavities were calculated. In the foreground stands the criticality problems of spherical-pile reactors: the change of the neutron flux and the multiplication constant in putting fuel in a reflecting hollow cylinder and the influence of reflector position on the reactivity. Neutron flux measurements in a graphite block with and without cavities were compared with results of calculations. (tr-auth)

24659 DRIVES FOR REACTOR-CONTROL-RODS. A SURVEY OF THE BASIC PRINCIPLES AND THEIR REALIZATIONS. B. Schallopp. Nukleonik, 5: 124-33(Apr. 1963). (In German)

As the design of control-rod drives is very closely dependent on the reactor configurations, different reactors are usually equipped with different drives. The demand on control-rod drives is briefly considered, and the fundamental principles of their design are discussed, in order to facilitate orientation among a multitude of particular designs, whether they are made up of conventional elements, or entirely newly constructed. A comprehensive reference list is given. (auth)

24660 COUPLING OF TWO NEUTRON-MULTIPLYING HETEROGENEOUS MEDIA. Paul Gavin, Charles Mandrin, and Bernard Vittoz (Université, Lausanne, Switzerland). Z. Angew. Math. Phys., 13: 201-23(1962). (In French)

Heterogeneous media that multiply neutrons, and that cannot be assimilated in homogeneous ones are investigated. These studies always postulate that the isolated medium is infinite, and never permit treating a multi-medium assembly. This problem is resolved by the intermediary of a simplified model, equivalent to the real one. Considering successively all the isolated medium and using the calculating method of heterogeneous media, the equivalent conditions are established. A safety calculation, for the exponential experiment of the EPUL, shows the use of this method. (auth)

24661 THEORETICAL AND EXPERIMENTAL STUDY ON REACTIVITY CHANGE IN REACTORS, CAUSED BY XENON POISONING. Walter Haelg (Technische Hochschule, Zurich), Heinrich Albers, and Zvi Doron. Z. Angew. Math. Phys., 14: 178-85(1963). (In German)

The calculation of the reactivity amount invested in the xenon poison involves the formation of an average to be calculated for the whole reactor, depending on a space- and time-dependent flux distribution. The relevant integrals were transformed into a form applicable for reactor operation. It is shown that the poisoning during the build-up of xenon can be expressed by an effective neutron flux. Contrary to this, the behavior of the reactivity after shut-down must be described by more than one effective parameter. Methods for the calculation of these parameters and their dependence on reactor geometry and power level are given. Finally numerical values for the research reactor DIORIT are evaluated and compared with the measured reactivity of the system. The agreement between experiment and theory is excellent, deviations being within the range of the experimental error. It is suggested to use the uniform xenon poison as a means to calibrate the total amount of reactivity of regulating devices. (auth)

24662 THE JOINT RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY DIGEST, PERIOD FROM APRIL 1 TO JUNE 30, 1961. Vol. 1, No. 3. (United States–Euratom Joint Research and Development Program). 43p. $5.00 per yr. (Euratom). (TID-18610)

Research and development progress is reported on nuclear fuels, reactor materials, nuclear engineering, and reactor physics. A list of contracts entered into before June 30, 1961, is given. Summaries of technical progress reports are included. (M.C.G.)

24663 THE JOINT RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY DIGEST, PERIOD FROM OCTOBER 1 TO DECEMBER 31, 1962. Vol. 2, No. 4. (United States–Euratom Joint Research and Development Program). 74p. $5.00 per yr. (Euratom). (TID-18611)

Research and development progress is reported on nuclear fuels, reactor materials, nuclear engineering, and reactor physics. A list of contracts entered into before December 31, 1962, is given. Summaries of technical progress reports are included. (M.C.G.)

24664 NUCLEAR REACTOR CONTROL ENGINEERING. Joseph M. Harrer (Argonne National Lab., Ill.). [1961]. 599p. D. Van Nostrand Co., Inc., Princeton, N. J. $16.50.

Concepts of logic circuit design, reactor control engineering, and reactor physics are presented. Use of commercial control devices and the use and manipulation of transfer functions are discussed, as are feedback control systems, reactor simulators, computers, and other elements of reactor control. An effort is made to point out problems and to provide control engineers with a compilation of know-how. (D.C.W.)

24665 HETEROGENEOUS NUCLEAR REACTOR. Rudolf Schulten, Wernfried Gueth, Andreas Setzwein, Helmut Braun, and Georg Berberich (to Brown, Boveri and Cie Aktiengesellschaft). U. S. Patent 3,089,835. May 14, 1963. Priority date Oct. 27, 1956, Germany.

A heterogeneous reactor is designed in which ball-shaped fuel elements are located in square channels with protuberances along their wall surfaces. The core is mounted between perforated plates, and the coolant channels are designed so as to cause thorough intermixing of the coolant in the space above the core. Means are provided for feeding the fuel balls to the top space for introduction into the channels. (D.L.C.)

24666 FUEL ELEMENTS FOR NUCLEAR REACTORS. Richard Valentine Moore (to United Kingdom Atomic Energy Authority). U. S. Patent 3,089,837. May 14, 1963. Priority date June 24, 1957, Great Britain.

A fuel element of the sleeve-rod cluster type is designed for use in a reactor with a re-entrant cooling system, e.g., a sodium-graphite reactor. The sleeve is located in thimble-shaped tubes in the reactor and has perforations in the region of the fuel to allow a fraction of the coolant to pass through the sleeve; thus, the pressure drop is reduced somewhat. (D.L.C.)

Power Reactors

Refer also to abstract 24100.

24667 (57GL237) PNEUMATIC SHIM-SCRAM ACTUATOR FOR ANP REACTOR CONTROL RODS. J. A. Pritzlaff (General Electric Co. General Engineering Lab., Schenectady, N. Y.). July 31, 1957. For General Electric Co. Aircraft Nuclear Propulsion Dept., Evendale, Ohio. Contract [AT(11-1)-171]. 30p.

The design and development of a shim-scram reactor rod actuator are described. Some of the design goals include: 20 in. total travel, shim rate of 12 in. per minute with 0.10 positioning increments, scram 10% full stroke in 0.075 seconds from any operating position, and operation at 500°F. The shim and scram devices were developed as separate,

but compatible, units. The shim device can move the reactor rod at travel rates of 45 to 50 inches per minute. The shim device has operated at 500°F. The scram device provides 10% of full stroke travel in 0.060–0.070 seconds. Energy dissipation of 99% is achieved at the end of the stroke by a pneumatic dashpot. (auth)

24668 (57GL238) PNEUMATIC STEPPER FOR SHIM CONTROL OF ANP REACTOR RODS. J. A. Pritzlaff (General Electric Co. General Engineering Lab., Schenectady, N. Y.). July 29, 1957. For General Electric Co. Aircraft Nuclear Propulsion Dept., Evendale, Ohio. Contract [AT(11-1)-171]. 53p.

The development of a pneumatic stepper for the shim section of a shim-scram actuator for ANP reactor controls is described. Some of the design goals included: stepping rate of 12"/min with 0.10" positioning increments and operation at 500°F. Precise positioning increments of 0.098 were obtained through the use of sequenced steps along a 32 pitch rack. Stepping rates of 45 to 50 inches per minute were achieved. Stepper operation at 500°F gave promising results. (auth)

24669 (57GL239) PNEUMATIC SCRAM SYSTEM FOR ANP REACTOR CONTROL RODS. D. E. Cain (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Nov. 4, 1957. For General Electric Co. Aircraft Nuclear Propulsion Dept., Evendale, Ohio. Contract [AT(11-1)-171]. 69p.

The development of the scram section of a pneumatic shim-scram rod for ANP is described. Scram sections consist of piston, dashpot, solenoid valve, scram valve, latch, and reservoir. A 10% (2 inch) stroke in 75 milliseconds from any rod stroke position was achieved. A 99% energy dissipation in the pneumatic dashpot was achieved. (auth)

24670 (57GL240) RECOMMENDED PNEUMATIC SHIM AND SCRAM COMPONENTS FOR ANP REACTOR CONTROL RODS. D. E. Cain (General Electric Co. General Engineering Lab., Schenectady, N. Y.). July 19, 1957. For General Electric Co. Aircraft Nuclear Propulsion Dept., Evendale, Ohio. Contract [AT(11-1)-171]. 22p.

Assembly drawings present recommendations based on experience with pneumatic shim-scram rods developed for the Aircraft Nuclear Propulsion Department. (auth)

24671 (ACNP-63003) HIGHLY SELF-SHIELDED BURNABLE POISONS. R. J. Holl (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Mar. 6, 1963. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 134p.

A new and different type of burnable poison element which can be used essentially to match any decreasing reactivity curve in a reactor and still have a tolerable residue was studied. Specific application is made to Gd as the poison elements; however, the results would be similar for any other suitable high cross-section element such as Cd. (J.R.D.)

24672 (ACNP-63005) PATHFINDER ATOMIC POWER PLANT. CLUSTERED PIN SUPERHEATER LATTICE EXPERIMENTS. A. Selep (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Feb. 12, 1963. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 72p.

Experiments to obtain detailed thermal flux distribution measurements within a unit fuel cell and measurements of sub-cadmium and epi-cadmium U^{238} absorption in the fuel rods are described. These quantities are required for determination of the thermal utilization and resonance escape probability of the fuel loading. (auth)

24673 (AECL-1730) POWER REACTOR DEVELOPMENT EVALUATION. A Summary Report by a Committee of AECL Staff. (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1, 1963. 25p.

In view of the competitive economic position and advanced stage of design and development, the D_2O-cooled reactor deserves priority for extension to higher power ratings and general improvement. Both 450 and 750 Mw(e) designs for D_2O-cooled reactors should be pursued for first application. The economic attraction of the organic-cooled design justifies its continued development. The advantages of higher pressure working steam and higher efficiency coupled with easier containment and lower toxicity in maintenance indicate that boiling (or fog) and organic-cooled designs should be pursued. The possibly lower cost of UC fuel suggests a further advantage of the organic-cooled designs but sets a challenge to fuel development for the water- and steam-cooled reactors. Development of the fog- and boiling-water-cooled channels should be continued. (N.W.R.)

24674 (BAW-1051) SUMMARY OF BABCOCK & WILCOX LMFR STUDIES. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Apr. 7, 1958. Contract AT(30-1)-1940. 16p.

Design and development work for the liquid metal fuel reactor concepts is summarized. Evaluations are presented on internally and externally cooled concepts, remote maintenance, power plant potentialities, chemical processing methods, economic aspects, and design of the first LMFRE. (N.W.R.)

24675 (DLCS-5000363) MONTHLY OPERATION REPORT, MARCH 1963. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 45p.

The Station generated electrical power continuously throughout the month maintaining a 100% electrical power output for 21 days. During a 10-day period the generated output was reduced approximately 10% by the outage of the 1B and 1C feedwater heaters. Following repairs to the heaters, the Station resumed full power operation. Specified water conditions were maintained in the RCS, the Reactor Plant auxiliary systems, and in the steam generators throughout the period. Personnel radiation exposures were within specified limits and conditions related to radioactive contamination were normal during the month. There were 2 tests completed during the period and 3 tests were still in progress at the end of it. Eleven test procedures, 4 test evaluations, 25 preliminary reports, and one special report were prepared and issued. Construction work continued on the installation of the Reactor Plant Fire Protection Sprinkler System, and on the modification of the HDS and the RWDS level instrumentation. (auth)

24676 (GA-2568) MARITIME GAS-COOLED REACTOR PROGRAM. Quarterly Progress Report for the Period Ending September 30, 1961. (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-187. 137p.

Included in the MGCR Project are the design, construction, and test operation of a 10-Mw(t) reactor experiment as an intermediate stage to determine the operating characteristics of BeO-moderated gas-cooled systems and to lend greater assurance of success to the subsequent prototype plant. This reactor experiment is known as the Experimental Beryllium Oxide Reactor (EBOR). A number of core design analyses and changes were made. These in-

cluded: thermal studies to determine allowable temperature conditions for the core element support riser top plate; an investigation to ascertain the need for the bottom head of the thermal shield; and a decision to abandon the concentric duct flow restrictor concept in favor of a pressure vessel design that receives all of the helium flow through the concentric duct. An analysis of the loss-of-coolant accident for the annular EBOR fuel element was made. Experiments to determine the circumferential variation of the heat transfer coefficient around a fuel rod were initiated. The irradiation of the MGCR-HDR-3 test fuel element in the Hanford DR-1 Gas Loop continued satisfactorily. The ball-nut lead screw environmental test program was completed. A modified 135 Nitralloy screw and tungsten carbide balls were found to constitute the best combination. The assembly of the MGCR control rod drive environmental test loop and associated instrumentation was completed. A revised design of the low-pressure turbine-compressor set is 70% complete. Compressor and turbine model testing was continued. Compressor model tests were carried out to determine the effect of stage loading and the effect of stator seal clearance on the performance of the compressor. Emphasis was placed on the incorporation of the DSN multigroup transport code into the EBOR and the critical assembly calculations. In addition, the GAM-1 and GATHER codes for the solution of epithermal and thermal spectra problems, respectively, and for the determination of spectra-averaged cross sections for subsequent diffusion theory calculations, were brought into use. The critical assembly program is continuing. Following the experiments on the lightly loaded simulated water-flooded assembly, the loading was doubled and additional measurements made. Dose rate calculations pertaining to both dry and wet fuel handling were made. The performance of the MGCR-4 fuel irradiation capsule in the MTR continued satisfactorily. The examination of BeO pellets from the MGCR-1 irradiation capsule was also continued. Crushing strengths of up to 88,000 psi were recorded. Extended time creep-rupture testing of Hastelloy-X, in various environments, is being directed toward the determination of the reason for the shorter-than-predicted rupture lives of various specimens. Investigations to determine the aqueous corrosion properties of various metallic materials were started. (auth)

24677 (GEAP-3474) 300 KWe CAPSULE NUCLEAR POWER PLANT STUDY. Preliminary Report. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 30, 1960. Contract AT(04-3)-189. 82p.

Progress made in the study of the feasibility of the concept, plant arrangement studies, and considerations pertaining to partial plant attendance for a 300-kw(e) unattended nuclear power plant is reported. It is concluded that both the indirect and direct boiling cycles are feasible. The recommended reference design is the direct cycle, in a single capsule, with the turbine, generator and pumps on a single shaft. (auth)

24678 (GEAP-4213) PHYSICS PRE-STARTUP REPORT. ESADA VALLECITOS EXPERIMENTAL SUPERHEAT REACTOR. A. J. Gietzen, T. Tillinghast, and M. L. Weiss (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 12, 1963. Contract AT (04-3)-189. 126p.

The scope of the initial core loading and critical testing program is defined, and acceptable methods for the execution of the tests are indicated. A compilation of results and conclusions from physics calculations performed to guide the testing and startup of the ESADA-Vallecitos Experimental Superheat Reactor (EVESR) is included. (auth)

24679 (MITNE-27) THE EFFECTS OF CHANGING ECONOMIC CONDITIONS ON ENERGY COSTS IN ZIRCALOY-4 CLAD PRESSURIZED WATER REACTORS. Max C. Richardson (Massachusetts Inst. of Tech., Cambridge). Dec. 1, 1962. 79p.

The effects of changing economic conditions on nuclear energy costs were studied for a 461 net electric megawatt, Zircaloy-4-clad pressurized-water reactor. The average burnup range studied was between 12,000 and 39,000 megawatt days per ton of uranium. This corresponds to feed enrichments between 2.00 and 3.50 wt % U^{235}. Batch and three and five zone out-in fuel management with uniform chemical shim poison control were studied. The cost variables studied were the cost of natural UF_6, the cost of separative work, fuel fabrication cost, reprocessing cost, plutonium credit, and interest charges on fuel. Five zone out-in fuel management gave the lowest fuel cycle cost for each feed enrichment and each cost basis. This was due primarily to the continued decrease in UF_6 cost and fabrication cost as the burnup of any particular feed enrichment was increased by increasing the number of zones. Even for the highest average burnup studied, the fuel cycle cost for every cost basis and every fuel management procedure was on the left hand side of the minimum of the fuel cycle cost versus burnup curve except for the cost basis in which a reduced fabrication cost was considered. With three zone out-in fuel management and 3.10 wt % enrichment, the average burnup was about 30,000 Mwd/t. For this case, the net equilibrium fuel cycle cost, using an 80% load factor, was 1.82 mills/kwhe for present cost conditions, with interest charges on fuel at 4.75%/year, and 2.08 mills/kwhe with interest charges on fuel at 12%/year. For three zone out-in fuel management and 2.75 wt % fuel enrichment, the fuel cycle cost increased by 0.1 mill/kwhe for each of the following changes: increase in interest charge on UF_6 of 4.63%/year; increase in cost of natural UF_6 of $3.03/kgU; increase in cost of separative work of $4.65/kgU; increase in fabrication cost of $15.63/kgU; increase in reprocessing cost of $20.05/kgU, and decrease in plutonium credit of $2.48/gmPu. (auth)

24680 (NAA-SR-5340) HYDRAULIC CHARACTERISTICS OF HNPF 19-ROD FUEL ELEMENT. J. A. Hagel (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1960. Contract AT(11-1)-Gen-8. 31p.

Pressure-drop measurements and vibration characteristics were obtained for 20 to 100% of design flow through a 19-rod fuel element considered for the first core loading of the Hallam Nuclear Power Facility (HNPF). The principles of dimensional similitude were applied to convert the data obtained with water as the test fluid to equivalent values for sodium. The over-all pressure loss across the element ranged from 0.031 to 6.8 psi over the sodium flow range of 1.4 to 22.5 lb/sec. Friction factors across the bundle and entrance and exit loss coefficients for the element were obtained for Reynolds numbers ranging from 13,000 to 130,000. No significant vibration of the rod assembly was induced by the flow of water. (auth)

24681 (NAA-SR-5947) DEVELOPMENT OF SHIM-SAFETY CONTROL ROD FOR THE HALLAM NUCLEAR POWER FACILITY. L. B. Copeland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 15, 1963. Contract AT(11-1)-Gen-8. 47p.

A shim-safety reactor control rod, including actuator mechanism and neutron absorber element, was developed for the Hallam Nuclear Power Facility 240-Mw(t), sodium-cooled, graphite-moderated reactor. Following design and fabrication of prototype components, subcomponent and full-

scale developmental testing was performed under ambient and elevated-temperature conditions. Selection of the neutron-absorber element, a mixture of gadolinium and samarium oxides clad by Hastelloy X, was preceded by an extensive developmental effort which included in-pile irradiation tests, materials compatibility tests, and development of fabrication techniques. (auth)

24682 (ORNL-TM-546) SPECIFICATIONS FOR FUEL ASSEMBLIES FOR CORE I OF THE EXPERIMENTAL GAS-COOLED REACTOR. J. H. Coobs, E. A. Wick, R. M. Evans, and G. M. Tolson (Oak Ridge National Lab., Tenn.). May 19, 1963. Contract W-7405-eng-26. 95p.

Supersedes CF-60-11-90.

As-built specifications for the fuel assemblies for Core I of the Experimental Gas-Cooled Reactor (EGCR) were developed for use in procuring the first core loading. A fuel assembly for the EGCR consists of a cluster of seven cylindrical fuel elements spaced and supported within a graphite sleeve. Each fuel element consists of a stainless steel tube containing a column of hollow UO_2 pellets with a spacer brazed at the midsection to control the spacing between fuel elements. A master specification for the fuel assembly, a supplementary specification for each of the components, a specification for record keeping during manufacture, a set of drawings, and a list of references are included. (auth)

24683 (ORNL-TM-547) SPECIFICATIONS AND DRAWINGS FOR THE CONTROL RODS FOR THE EXPERIMENTAL GAS-COOLED REACTOR. J. H. Coobs, N. A. Brown, R. M. Evans, and G. M. Tolson (Oak Ridge National Lab., Tenn.). May 29, 1963. Contract W-7405-eng-26. 48p.

Specifications are given for EGCR control rods, which are of articulated construction and are composed of four sections. The lower three sections consist of boron carbide brushings clad with stainless steel and the upper section is stainless steel. The four sections are connected by a stainless steel rod through the center. They are cooled by a helium stream. (M.C.G.)

24684 (PRDC-TR-64) MONTHLY TECHNICAL REPORT [ON APDA ACTIVITIES], OCTOBER 1962. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 18p.

Research and development progress is reported on fuels and metallurgy, chemistry and materials, physics, computer programs, systems, mechanical design, and electric systems and instrumentation. Test operations are described. Results of airborne dust sampling and analysis programs for October 1962 are included. (M.C.G.)

24685 (PRDC-TR-66) MONTHLY TECHNICAL REPORT [ON APDA ACTIVITIES] DECEMBER 1962. (Power Reactor Development Co., Detroit). Contract AT (11-1)-476. 17p.

Progress is reported on APDA activities including: fuel and metallurgy research, chemistry and materials research, engineering analysis, physics research, systems development, mechanical design, electrical system and instrumentation development, and test operations. Results of the airborne dust sampling and analysis program are presented. (M.C.G.)

24686 (SL-1974-4) ENGINEERING EVALUATION STUDIES, HEAVY WATER MODERATED POWER REACTOR PLANTS. Quarterly Progress Report, January–March 1963. (Sargent and Lundy, Chicago). Apr. 30, 1963. Contract AT(38-1)-213. 34p.

Work on the computer program for the economic optimization of D_2O moderated power reactors is continuing. The performance and cost data for all the turbine plants and the boiling-D_2O-cooled, liquid-D_2O-cooled, and organic-cooled reactor plants are complete. Three plant capacities are covered by the data: 300, 500, and 1000 Mw(e). Cost data for the fossil fired superheaters were compiled and are presented. (auth)

24687 (SRO-82) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, APRIL 1963. (Savannah River Operations Office, AEC). 12p.

Research and development is reported on the AEC-AECL cooperative program, sintered aluminum products, nondestructive tests, header and feeder piping fluid dynamics, zirconium technology, heat transfer at low heat flux, increased capacity of heavy water plants, hydraulic-ball control system, reactor physics, Heavy Water Components Test Reactor, and Carolinas-Virginia Tube Reactor. (M.C.G.)

24688 (TID-18568) ELK RIVER REACTOR VESSEL LIFETIME CYCLIC TEST PROGRAM. Progress Report No. 1. Clarence E. Lautzenheiser, Alfred L. Lowenberg, and Allen R. Whiting (Southwest Research Inst., San Antonio). Apr. 18, 1963. Contract AT(11-1)-1228. 69p.

Preliminary activities in a program to evaluate the effects of defective overlays on the fatigue life of reactor pressure vessels are reported. Plans for evaluation of overlays which contain martensitic cracks, austenitic cracks, and overlays with no defects are discussed. Other work is reported on the use of nondestructive testing methods to improve knowledge and procedures for determination of crack initiation and propagation rates in pressure vessels subjected to low-cycle plastic fatigue. Results indicate that defects do not have propagation rates which are linear with time under low-cycle plastic fatigue conditions. No appreciable growth occurs until a critical number of fatigue cycles is reached. (J.R.D.)

24689 (TID-18582) A SYSTEM ANALYSIS OF THE LIQUID METAL FUEL REACTOR EXPERIMENT. Final Technical Report. Gilbert S. Stubbs, William H. Steigelmann, Edward W. Jones, Tsi C. Yen, and Musa Halev (Franklin Inst. Labs. for Research and Development, Philadelphia). For Babcock and Wilcox Co., [Lynchburg, Va]. Contract [AT(30-1)-1484]. 390p. (F-A2199)

The results of a study made of the dynamic characteristics of the LMFRE-1 primary system are presented. General frequency response transfer functions are derived for both the neutron kinetics of a circulating fuel system and the heat transfer characteristics of various regions in the reactor system. Use of the Franklin Institute SADSAC (SAmpled-Data Simulator And Computer) permitted a very detailed analog representation of the LMFRE-1 system. Techniques are described for applying the SADSAC to the simulation of this system. The analog representation consisted of: (1) a thirteen-axial-region nuclear model of the reactor core which included six delayed neutron groups for each region, (2) a thirteen-axial-region thermal model of the reactor with six radial-regions to account for heat generation in the side reflector and in the graphite moderator owing to fuel absorption, (3) a twenty-section model of the intermediate heat exchanger, and (4) all of the transport lags within and between the various regions and components in the primary system. Transient response computations of both open-loop and closed-loop models of the LMFRE-1 primary system were made using the SADSAC. These computations include sixty-two sets of transient conditions covering initial power levels from zero to five megawatts. Curves are presented which show the excellent agreement between the frequency response characteristics

of the LMFRE-1 intermediate heat exchanger as measured on the SADSAC and those computed by use of the exact transfer functions on a digital computer. (auth)

24690 NUCLEAR POWER PLANTS IN ENGLAND AND WALES. Atom, No. 79, 165-76(May 1963).

The electric power situation in England is discussed, and it is shown that nuclear power plants, in order to give the greatest benefit, should be located on coastal sites in the South. The various problems encountered in the siting, construction, and mechanical design of nuclear power plants are reviewed. Each of the power plants already constructed or being built is discussed. The advantages of the prestressed concrete pressure vessel to be used at Oldbury are discussed. (D.L.C.)

24691 SPECTRAL SHIFT CONTROL REACTOR. W. Junkermann. Atomkernenergie, 8: 121-5(Apr. 1963). (In German)

Since pressurized water reactors proved to be satisfactory in their technology, it is essentfal that they should also be enabled to compete with conventional steam generators from an economic point of view. This will be achieved by an operation method described for the Spectral Shift Control Reactor working with a variable moderator mixture of heavy and light water. The advantages involved are stated. The process operates without any risk and without new design elements. In economic respects the principle of the pressurized water reactor is shown to be improved by flattening the neutron flux, avoiding superfluous absorption losses, and achieving a high conversion rate. Careful studies proved the SSCR can compete with and may even be superior to conventional steam generation plants. (auth)

24692 HIGH TEMPERATURE REACTOR DEVELOPMENT BY BBC/KRUPP. R. Schulten and O. Machnig (BBC/Krupp, Reaktorbau GmbH, Mannheim, Ger.). Atompraxis, 9: 117-24(Apr. 1963). (In German)

The pebble-bed reactor is a gas-cooled high temperature reactor, known by its simple charge-discharge mechanism, increased burn-up rates, and high serviceability. The fuel-element development is of major significance besides problems of mechanical resistance of heat transfer and retention of fission products inside the fuel element. Fuel elements of homogenous and heterogenous structure can equally be used. Due to the choice of graphite as structural material for the element as well as for the reflector, special conditions for the coolant purity must be observed in order to reduce the reaction, rate of impurities with graphite. The self-supporting reflector has to withstand the lateral pressure of the pebbles. Besides this static pressure, heat stresses are raised. These tensions will determine the design of reactors with high power density. The reactor AVR will be in operation in 1964. (auth)

24693 DEVELOPMENT TRENDS IN THE GERMAN ATOMIC INDUSTRY. F. Flick (Deutsche Atom-Forum ev, Bonn). Atompraxis, 9: 124-9(Apr. 1963). (In German)

A consideration is given of the present extent of German atomic industry. A survey is made of the development and construction of power reactors in Western Germany, and uranium-ore mining and the manufacture of nuclear fuels are discussed. In conclusion, certain central problems in the production, distribution, and utilization of radionuclides are pointed out. Stress is placed on the importance of applying the principles of free enterprise, wherever economically and technically feasible, in the field of radionuclide production and distribution. The interrelationships between political, economic, and technical problems in the field of nuclear-energy exploitation are also pointed out. In order to keep abreast of developments in the other important industrial nations of the West, Germany must be prepared to spend ca. one billion marks per year for work in the peaceful applications of atomic energy. (auth)

24694 THE DEVELOPMENT OF HEAVY-WATER MODERATED POWER REACTORS IN GERMANY. B. C. Drude (Siemens-Schuckertwerke AG, Erlangen, Ger.). Atompraxis, 9: 129-32(Apr. 1963). (In German)

After a brief discussion of the advantages of using natural uranium or fuel with minimum enrichment, a description is given of the two types of D_2O-moderated power reactors developed in Germany. These are the MZFR, a pressure vessel reactor now under construction at Karlsruhe, and a pressure tube reactor developed for the "Atomkraft Bayern." In conclusion, reference is made to a number of similar projects abroad. (auth)

24695 FUNDAMENTAL ASPECTS OF AEG NUCLEAR POWER PLANT PROJECTS. J.-J. Bruechner (Abteilung Kernenergie-Anlagen der AEG, Frankfurt am Main). Atompraxis, 9: 132-5(Apr. 1963). (In German)

The most important characteristics of AEG nuclear power plant projects with boiling water reactor are described. The following boiling water reactor projects are treated: Nuclear Power Station Kahl with indirect cycle and natural circulation, a 100 Mw(e) nuclear power plant with direct cycle and forced circulation, the 250 Mw(e) nuclear power plant Gundremmingen with dual cycle and forced circulation as well as a single region superheat reactor. (auth)

24696 PROBLEMS OF NUCLEAR-POWERED SHIPS. D. Ulken (Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht-Elbe, Ger.). Atompraxis, 9: 140-5(Apr. 1963). (In German)

In recent years various projects for ship reactors have been worked on in Germany. Detailed problems of the interactions between the ship and its nuclear power plant have been studied and, if possible, experimentally clarified. In support of these theoretical and experimental studies, a research ship is being built; however, its reactor is not yet economically competitive with conventional power plants. A description is given of the various ship-reactor projects, together with the studies and experiments which have been planned. (auth)

24697 NUCLEAR-POWERED AIRCRAFT. H. N. Schludi (Junkers Flugzeug- und Motorenwerken AG, Munich). Atompraxis, 9: 146-50(Apr. 1963). (In German)

The development of nuclear-powered aircraft was formerly carried on with a view to military use. But after military aircraft declined in strategic importance, there was little reason left for continuing to develop nuclear-powered aircraft. However, a comparison between conventional and nuclear-powered commercial planes shows that the latter can carry a larger payload. Thus, once nuclear-planes are available, supersonic air transport will probably be more economical than it is at present. The development of a nuclear reactor to power these planes will also generally stimulate the European nuclear-rocket and aircraft industry. (auth)

24698 PRODUCTION OF NUCLEAR ENERGY. E. Kern (Technische Uberwachungs-Vereine, Essen). Brennstoff-Wärme-Kraft, 15: 179-81(Apr. 1963). (In German)

Nuclear energy production in 1962 is discussed. Topics covered include: power reactors, the German reactor

program, EURATOM, and development of fast breeders. (M.C.G.)

24699 PROGRESS AND DEVELOPMENT TRENDS IN THE DESIGN OF GAS COOLED POWER REACTORS OF THE GRAPHITE MODERATED NATURAL URANIUM TYPE. [PART 1.] P. V. Gilli. Elektrotech. Maschinenbau, 79: 537-45(Nov. 1962). (In German)

A review is given of the development and construction of gas-cooled, graphite-moderated reactors using natural uranium clad in Magnox as fuel, with emphasis on the fuel element characteristics and the core behavior. The characteristics of reactions of this type now in operation or under construction are shown in tabular and graphic form. The pressure vessels and steam generators of such reactor systems are also considered. (J.S.R.)

24700 THE COST RATE OF ELECTRICAL ENERGY FROM SMALL NUCLEAR POWER PLANTS AND ITS USE IN THE CHEMICAL INDUSTRY. M.-J. Deutch. Energie Nucl., 5: 81-4(Mar.-Apr. 1963). (In French)

The technical feasibility of large atomic power plants has now been proven. But in chemical plants located in isolated areas, the need for autogenerated power is considered unlikely to be met by atomic power because: chemical processing industries requires small power units (20,000 to 30,000 kw) or medium-size power plants (at most between 40,000 and 60,000 kw). It was concluded that the economic practicability of small atomic units is doubtful except under most special circumstances. (auth)

24701 THE PROBLEM OF ATOMIC POWER. V. Emelyanov (Emélianov). Energie Nucl., 5: 115-18 (Mar.-Apr. 1963). (In French)

The means which can be envisaged in order to solve the problems posed by the production of nuclear power, and, in particularly, to reduce its cost are examined including: utilization of rapid neutrons, control of thermonuclear fusion, and quest for new fissionable materials and nuclear processes. (auth)

24702 THE CONTAINMENT BUILDING FOR THE ADVANCED GAS-COOLED REACTOR, WINDSCALE. N. T. Barrett, J. J. Haftke, and W. J. M. Davies. J. Brit. Nucl. Energy Soc., 2: 137-46(Apr. 1963).

The Containment Building must not only carry the pressure and temperature loads imposed upon it but also provide all the normal functional requirements of a building. To minimize the conflicts which arise between these two major functions, the internal structure has been designed to be self-supporting so that the containment shell is free-standing and only restrained at its base. (auth)

24703 AGR RESEARCH AND DEVELOPMENT PROGRAMME. H. Kronberger. J. Brit. Nucl. Energy Soc., 2: 225-8(Apr. 1963).

Some of the novel design features of the Windscale AGR and its development program are described. The developmental facilities, including the AGR irradiation facilities and critical assemblies, are described. The development problems encountered, e.g., graphite–CO_2 reactions and fuel elements, are discussed. Planned development work for the future is described briefly. (D.L.C.)

24704 ATOMIC ENGINES. Jen Fan. K'o Hsueh Ta Chung, No. 4, 172-3; 175(1960).

Aviation engines using atomic and thermonuclear fuels are described. The basic constructions and defects are given for three types of atomic airplane engines: closed-type cyclic propeller engines; pulsating-type engines; and turbo air compressor type engines. The last engine is an indirect type in which a heat exchanger is used for contact with and to heat the air. Also mentioned are the atomic turboprop engine and the combination-type engine. It will be necessary for future thermonuclear engines to install a magnetic system for engine cooling and a special conveying system for the propellent. (OTS)

24705 ANALOGUE INVESTIGATION OF THE STABILITY OF A GRAPHITE POWER REACTOR. V. R. Sastry and J. W. Lynn (Univ. of Liverpool). Proc. Inst. Elec. Engrs., (London), 110: 812-20(Apr. 1963).

The causes and nature of instabilities in a graphite power reactor are described. A model of the reactor is chosen that is simple enough to be simulated on a laboratory analogue but includes the essential features of the problem. That the results and conclusions from the smaller system are to a large extent valid for practical cases seems to be borne out by earlier investigators. The stability of a cylindrical reactor, divided into two active regions, was studied, first with one control rod for each region and later with just a single regulating control rod in the reactor. Each region is simulated as a point reactor coupled to the other region by neutron diffusion. The error signal for the control system is obtained from the change in mean fuel temperature. No dead bands or saturation are provided in the control system. For stable operation of a reactor the lower and upper limits for the controller gain and the nature of the oscillations at these boundaries are investigated. With one control rod, spatial oscillations of power are studied. The effects of variation of moderator temperature coefficient, the equilibrium flux level, and the location of the control rod were examined. With the help of simplifying assumptions, certain of the above cases were investigated analytically and compared with the computer results. (auth)

24706 HYDRODYNAMICS OF A STEAM GENERATOR IN A TWO-CIRCUIT NUCLEAR POWER PLANT. G. G. Bartolomei, V. A. Suvorov, and S. A. Tevlin (Inst. of Power Engineering, Moscow). Teploenerg., No. 1, 52-8(Jan. 1963). (In Russian)

Descriptions are given of a heat transfer scheme for a dual-cycle, water-moderated, water-cooled reactor. The hydrodynamics of the steam generator and large-parameter bubble installations are investigated. (R.V.J.)

24707 ON SUPERHEATED STEAM IN NUCLEAR POWER PLANTS. T. Kh. Margulova (Inst. of Power Engineering, Moscow). Teploenerg., No. 6, 39-41(June 1962). (In Russian)

Two superheating schemes are presented for dual-cycle high-parameter nuclear power plants. In the first scheme the saturated steam produced in a reactor is passed on to a nuclear superheater. In the second scheme the reactor steam is superheated in a special liquid or gaseous fueled superheater. Both schemes are analyzed. (R.V.J.)

24708 DUNGENESS NUCLEAR POWER STATION. Welding Metal Fabric., 30: 407-9(Oct. 1962).

Construction work on the Dungeness station, a 550-Mw nuclear power plant using two CO_2-cooled, graphite-moderated reactors, was begun in August 1960. The new fabrication techniques being used in the construction are described briefly. (D.L.C.)

24709 LUBRICANTS FOR NUCLEAR POWER STATIONS. E. Sommer. Zucker, 15: 147-50(Mar. 1962). (In German)

Intensive investigations on lubricants for nuclear power stations showed that the radiation type is less important than the radiation intensity. In general, the viscosity and lubricating capacity increased under intense γ radiation. However, paraffinic lubricants were much more radiation

sensitive than naphthenic, benzenic, or other aromatic oils. For high temperature resistance, silicon oils are preferred to mineral oils in spite of their somewhat lower lubricating capacity. Most experiments leading to suitable lubricants for power stations were not made in the atomic reactor but by exposing the oils in specially constructed apparatus to intensive Co^{60} γ radiation and subsequent electron microscopic, chemical, and mechanical evaluation. (OID)

24710 NUCLEAR REACTOR PLANT. Kristian Dahl Madsen (to Allmanna Svenska Elektriska Aktiebolaget). U. S. Patent 3,089,834. May 14, 1963. Priority date Feb. 29, 1956, Sweden.

The problems of high pressures and large pressure vessels in nuclear power plants may be solved by constructing the vessel with a comparatively small wall thickness and fitting it into a space formed in rock. Concrete or water may be used in the space between the rock and the vessel to absorb stresses. Two embodiments of the invention are described. (D.L.C.)

24711 PRESSURIZED WATER NUCLEAR REACTOR. William R. Wootton (to Babcock and Wilcox Ltd.). U. S. Patent 3,089,836. May 14, 1963. Priority date Jan. 31, 1957, Great Britain.

A pressurized water reactor is designed with means for removing or inserting fuel or control elements from or into the core. The means comprises an auxiliary pressure chamber above and communicating with the main pressure vessel, and claw means for lowering or raising fuel elements. The auxiliary pressure chamber is filled with water and is provided with transfer chambers. The core is movable within the pressure vessel in order to be positioned relative to a charging-discharging aperture. (D.L.C.)

Research Reactors

24712 (BAW-1266) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM. Quarterly Technical Report No. 9, October–December 1962. (Babcock and Wilcox Co., Lynchburg, Va.). Contract AT(30-1)-2602. 5p.

Work performed on the Spectral Shift Control Reactor basic physics program is summarized. The major objective is to study the nuclear properties of slightly enriched lattices moderated by D_2O-H_2O mixtures. Critical experiments were performed with 2.46%-enriched UO_2 fuel rods in a lattice having a nonmoderator-to-moderator volume ratio of 0.65. Moderator compositions were 85.5 and 70.0 mole % D_2O. Reported for each of the two cores are critical size, $d\rho/dh$, buckling and reflector savings, thermal disadvantage factor, and cadmium ratios of U^{235} and U^{238}. The first Small Lattice Experiment (SLE) was completed, and the data, results, and conclusions are reported. The objective of the first experiment was to demonstrate the validity of the PCTR technique extended to epithermal systems. Measurements of k_∞, thermal disadvantage factor, and cadmium ratios of U^{235} and U^{238} are reported for an epithermal lattice of 4%-enriched UO_2, at a nonmoderator-to-moderator volume ratio of 1.0, moderated by a 69.7 mole % D_2O-H_2O mixture. The data are in good agreement with similar measurements in an equivalent critical assembly; this agreement substantiates the validity of the SLE technique and method of analysis. Final modifications of the BPG code are reported. The revised version, known as BPG-2, is now ready for final calculations. Preliminary results of BPG and P1MG comparisons of four clean lattices are discussed. (auth)

24713 (HW-SA-2997) APPROXIMATE METHOD FOR ANALYZING A NUCLEAR EXCURSION IN A LOW POWER, WATER MODERATED TEST REACTOR. W. K. Winegardner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 25, 1963. Contract AT(45-1)-1350. 13p.

An approximate method is presented for analyzing the effects of nuclear excursions in a very low-power, water-moderated test reactor. The analysis was developed to study transients in a reactor consisting of a cylindrical, unpressurized tank containing vertically oriented fuel elements suspended in the moderator. Both metallic and ceramic fuel elements of cylindrical geometry are used. Water in the tank serves as both moderator and coolant. Equations are included in the analysis to estimate the effect of various inherent shutdown mechanisms that exist in reactors of this configuration. Equations are given to determine the reactor power and fuel element core and surface temperature as a function of time. Equations are also included to estimate the reactivity effect of increasing fuel element and moderator temperatures, steam formation at the fuel element surface, and radiolytic decomposition of the moderator. Analog computing techniques are required for rapid analysis because the simulation requires solution of several simultaneous differential equations. (auth)

24714 (IDO-16768) TRANSIENT TESTS OF THE BSR-II CORE IN THE SPERT I FACILITY. L. A. Stephan (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 5, 1963. Contract AT(10-1)-205. 44p.

A series of transient tests was performed in Spert I with the Bulk Shielding Reactor II (BSR-II) core to determine the self-limiting properties of this core and to test the response of the reactor control system. The experimental program included measurements of the static parameters, self-limiting transient tests, control-system-shutdown transient tests, low-level start-up tests, and determinations of the reduced prompt neutron lifetime by dynamic and static techniques. The kinetic behavior of the BSR-II self-limiting transient tests showed a general similarity to behavior of self-limiting transient tests performed on other plate-type cores tested at Spert. The control system was found to be more effective in terminating power bursts than was the inherent self-shutdown of the reactor for excursions initiated by reactivity additions of up to an excess reactivity of about 1.8 dollars, corresponding to a reactor period of about 3 msec. For reactivity insertions larger than 1.8 dollars, self-shutdown was more effective than shutdown by external controls in limiting the excursion. In the short-period region where limited or total core damage can occur, no increased protection to the reactor is provided by the control system. (auth)

24715 (NP-12754) HAZARDS SUMMARY REPORT FOR 250 KW MARK II TRIGA REACTOR (PULSING) TO BE LOCATED AT COLUMBIA UNIVERSITY. Leon J. Lidofsky (Columbia Univ., New York). Mar. 1, 1963. 115p.

An analysis was made of the hazards of location of the 250-kw Mark II TRIGA Reactor at Columbia University. Topics covered include: environmental conditions and description of area, building design, reactor design, anticipated uses for the reactor, administration and organization, rules for operation and emergency procedures, potential hazards associated with operation of the reactor, and external hazards. (M.C.G.)

24716 (NP-12794) PRELIMINARY HAZARDS SUMMARY. SOLID-FUELED CRITICAL EXPERIMENT FA-

CILITY (SCEF), NASA LEWIS RESEARCH CENTER. Patrick M. Finnegan (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1962. 221p.

The Solid-Fueled Critical Experiment Facility (SCEF) will be used to investigate various reactor concepts having possible application in the NASA program of space research. Preliminary safeguards and hazards summary for the SCEF is intended to supply the technical information necessary to obtain an AEC reactor construction permit. Upon completion of construction, the final safeguards and hazards summary describing the as-built facility will be submitted and an AEC license to operate the facility will be requested. (auth)

24717 (ORNL-TM-577) MAGNET DATA FOR REDESIGNED ORR CONTROL ROD MECHANISMS—INFORMATION SEQUENCE AND QUANTITATIVE ANALYTICAL FORM FOR COMMUNICATION BETWEEN MAGNETIC AND MECHANICAL MAN POWER. J. Foster (Oak Ridge National Lab., Tenn.). May 23, 1963. Contract [W-7405-eng-26]. 7p.

A brief analysis of the required information sequence for converging both magnetic and mechanical design parameters upon a specific redesign of the magnet-actuated ORR control rod release mechanism is presented. A quantitative analytical language for communication between magnetic and mechanical design disciplines is suggested to facilitate an enduring and unambiguous flow and record of design information and agreement. (auth)

24718 SOME CONSTRUCTIONAL FEATURES OF THE BR2 NUCLEAR REACTOR. J. Brognaux, N. Point, and G. Boutique. ACEC Rev., No. 3, 16-41; No. 4, 18-38(1962).

A complete description is given of the design and construction of BR2, a very high neutron flux reactor for materials testing. The complete reactor installation, the safety container, the reactor vessel, control system, pumps, and emergency generating equipment are described. (D.L.C.)

24719 THE HERALD RESEARCH REACTOR AT A.W.R.E., ALDERMASTON. Atom, No. 79, 153-7(May 1963).

The reactor area at Aldermaston has been declassified for use by research workers from universities. A description is given of HERALD, a 5-Mw pool reactor which is to be modified. Its core mockup (HORACE) and irradiation programs are discussed. (D.L.C.)

24720 HARWELL'S REACTORS. Atom, No. 79, 158-64(May 1963).

The organization of the Research Reactors Division and the staff requirements for the operation of the research reactors are discussed. A table and a graph are given to illustrate the utilization of DIDO, PLUTO, and BEPO by various divisions and from 1959 to 1962. The other reactors are considered in turn, and their improvements are described. The general-purpose facilities available to users are described. (D.L.C.)

24721 HIGH FLUX RESEARCH REACTORS. P. Delattre (Commissariat à l'Energie Atomique, [Paris]). Energie Nucl., 5: 75-80(Mar.-Apr. 1963). (In French)

The utilization of high-flux reactors for production of stable and radioisotopes and transuranium elements is reviewed. The necessity for a high flux is discussed. (L.T.W.)

24722 PROBLEMS ENCOUNTERED DURING DESIGN, FABRICATION AND CONSTRUCTION OF JRR-3. Shoichi Hirayama, Tatsuo Yatsurugi, and Noboru Amano (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 5: 316-24(Apr. 1963). (In Japanese)

JRR-3, (natural uranium-heavy water moderated and cooled research reactor) went critical on Sept. 12 in 1962, and at present measurements are being made of its characteristics at low power. The measured data will be compared in detail with design calculations, and the full power of 10 Mw thermal is expected to be attained during 1964. The preliminary design study for JRR-3 was started in 1954, when for the first time in Japan budgetary appropriation was made for research and development in atomic energy. Since 1956, work on JRR-3 has been under the charge of JAERI. Detailed design began in April 1957 with the cooperation of Japanese industrial companies. Construction work started in the beginning of 1959. Some problems encountered during these 6 years are described. (auth)

SPACE APPLICATIONS AND TECHNOLOGY

24723 (AD-282752) SPACECRAFT ELECTRIC GENERATING AND PROPULSION SYSTEM INTEGRATION. First Quarterly Status Report for Period Ending June 30, 1962. (General Electric Co. Spacecraft Dept., Cincinnati). Includes Report DM-62-126: APPLICATION OF A 300 KW ARC JET PROPULSION SYSTEM. H. E. Nicoll, Jr. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 26, 1962. Contract AF33(657)-8488. 49p.

Work is being carried out to develop, demonstrate, and provide a working manual for the system design analysis and optimization procedure known as LEADER and to apply this procedure to space power generating and electrical propulsion systems of the SPUR type. The LEADER procedure consists of a mathematical model generating process and an optimization process. Two problems were undertaken to illustrate the LEADER procedure. The space transmissions line problem and the LEADER computation program development are discussed. Preliminary mission analyses were initiated to determine the applicability of a 300-kw arc-jet propulsion system in the performance of satellite distribution, maintenance, and repair functions. (M.C.G.)

24724 (AI-7950) APPLICATION OF SNAP 2 TO MANNED ORBITAL SPACE STATIONS. H. N. Rosenberg, ed. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 16, 1962. 90p.

The results of a study of the installation and operational characteristics of a SNAP reactor system integrated with a manned space station are presented. The reference system selected was an 11 kw(e) version of a SNAP 2 system employing multiple power conversion units coupled to a single reactor source. Of prime importance is the reactor radiation shield required for the manned system and the use of design features which minimize the shield weight. The weight of the radiation shield is highly dependent upon the geometrical configuration of the space station and the reactor since "shadow" shielding of the manned compartments is required for minimum weight systems. The installation and shielding requirements of the 11 kw(e) system were considered for two types of space station configurations; one was a 10 ft dia cylindrical station with a reactor separation distance of 50 ft and the other a 150 ft dia toroidal station with the reactor located in the hub. The weight of the power system installed in the cylindrical space station was about 9000 lb of which 6000 lb was required for shielding. The weight of the system for a toroidal station was ~25,000 lbs of which 20,000 lbs was required for shielding. However, these weights are relatively insensitive to power level and doubling or tripling the power output will only increase these weights by a small percentage. In addition, the designs developed for these two concepts permit the replacement of the reactor and power conversion system with the radiation shields becoming essentially a permanent part of the space station. Hence the large weight penalty associated with the reactor shield only has to be incurred once during the life of the space station. Because of the dominance of the reactor shield weights for manned systems, parametric curves of shielding weight are presented to enable the space vehicle designer to estimate nuclear power system weights for configurations other than those selected in this report. (auth)

24725 (ASD-TDR-62-827) FEASIBILITY DETERMINATION OF A NUCLEAR THERMIONIC SPACE POWER PLANT. Final Report, April 1, 1961 to August 31, 1962. K. E. Buck, C. R. Fisher, and I. M. Rehn (Aerojet-General Nucleonics, San Ramon, Calif.). Oct. 15, 1962. Contract AF 33(616)-8119. 150p. (AN-700; AD-293453)

The first phase of a program to determine the feasibility of a nuclear space-power system that utilizes a thermionic radiator is described. In this concept, thermionic converters are mounted in the radiator of the power plant and lithium is circulated directly from the reactor through the radiator. Fins attached to the anode reject waste heat to space. The basic feasibility of the thermionic radiator concept was demonstrated. An electrically heated, refractory metal (Cb-1Zr) test loop which incorporated a centrifugal pump, thermionic converter, heat sink, and regenerator was constructed. Lithium was circulated to the thermionic converter at temperatures ranging from 2150 to 2260°F. A cylindrical thermionic converter with a cathode surface area of 80 cm^2 was operated at power densities up to 1 w/cm^2. Limited systems analysis was carried out to establish the potential performance of the power plant concept. (auth)

24726 (ASD-TDR-62-877) ADVANCED SOLAR THERMIONIC POWER SYSTEMS. [Period Covered] June 1960 to August 1962. (Thompson Ramo Wooldridge Inc., Cleveland). Aug. 1962. Contract AF 33(616)-7411. 239p. (ER-5038; AD-295917)

A state-of-the-art survey of all components required for solar thermionic power systems in the 1–10 kw range suitable for application in aerospace vehicles is presented. The results of the survey and development program are used in a comprehensive parametric study to determine design criteria. The development program includes evaluation of thermionic converters of the vacuum and vapor type. Design, fabrication, performance, and evaluation of thermionic converters and generators are presented. The design, performance, and test specification for a 1.5 kw, 28 volt solar thermionic power system are presented. (auth)

24727 (LADC-5490) STATUS OF LASL ROVER PROGRAM. F. P. Durham (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 3p.

In 1962 testing of the Kiwi-B-1B reactor was accomplished by starting the reactor and bringing it to high power and temperature with liquid hydrogen as the coolant. While the B-1B test successfully demonstrated that a reactor could be started with liquid hydrogen in agreement with the calculated behavior, it also disclosed a structural weakness evidenced by core damage and the ejection of fuel elements from the nozzle when the reactor had reached 60% of design power at intervals thereafter during the test. Other designs are being developed, and tests in support of Rover flight safety information are being planned. Work on advanced reactors, called Phoebus, is being performed. (M.C.G.)

24728 (MND-P-2953) SNAP PROGRAMS-UPPER ATMOSPHERE EXPERIMENTAL RE-ENTRY STUDY. Final Summary Report. William Hagis (Martin-Marietta Corp. Aerospace Div., Baltimore). Apr. 1963. Contract AT(30-3)-217. 86p.

An experimental flight test was made to verify and im-

prove the methods and techniques used to predict the aerothermodynamic effects on re-entering SNAP devices. The amount of aerodynamic heating as a function of body shape, size, and mode of entry was indicated. Test specimens yielded trajectory, aerodynamic heating data, heat distribution, and heat transfer of known bodies. IBM 7090 digital programs were utilized and so constructed that one digital code complemented the other, i.e., at any time during the re-entry period, the complete thermal history of the body is known. The test specimens consisted of lead bodies containing alkali metals, used as flaring material, and a larger titanium cylinder containing telemetry equipment to monitor the exterior and interior wall temperatures during re-entry. By judicious placement of transducer sensors, aerodynamic heating rates and mode of entry, i.e., tumbling, spinning, and/or stabilized, were determined. The lead bodies were consumed at high altitudes whereas the telemetry capsule survived re-entry. (auth)

24729 (NASA-TN-D-1665) NUMERICAL EVALUATION OF ION-THRUSTOR OPTICS. Vladimir Hamza and Edward A. Richley (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). May 1963. 41p.

A numerical solution of the two-dimensional Poisson equation with mixed boundary conditions is presented. Solution of the matrix equation by the Cyclic Chebyshev Semi-Iterative method is described. The solution is obtained on an IBM 7090 computer. The method of analysis is demonstrated for an electrostatic thruster for four different ion-emitter contours. Average current densities and percent intercepted current are given for the four examples over a range of net-to-acceleration-voltage ratios. Results of the analysis are compared with data obtained from an experimental thruster. (auth)

24730 ELECTROMAGNETIC TORQUES OPERATING ON SATELLITES USING SNAP REACTOR POWER SYSTEMS. J. H. Bick (North American Aviation, Inc., Canoga Park, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 963-4(Apr. 1963).

The electromagnetic torques developed by the interaction of the electric and magnetic fields generated by SNAP reactor power systems in satellites with the geomagnetic field are investigated. The torques are expressed as a function of time in order that they may be used as an inhomogeneous forcing function in the dynamic altitude control equations for the satellites. (C.E.S.)

24731 NUCLEAR ROCKET THRUST OPTIMIZATION USING DYNAMIC PROGRAMMING. Robley E. George (Douglas Aircraft Co. Inc., Santa Monica, Calif.). AIAA (Am. Inst. Aeron. Astronaut.) J., 1: 1159-66(May 1963).

The problem considered is that of maximizing the burnout velocity of a solid core nuclear rocket. The optimal thrust schedule was shown, for a range of realistic parameter values, to differ from the well-known result for chemical systems because of the necessity to remove core fission product decay afterheat. This afterheat, which must be removed if the core is to remain intact, is a function of the reactor operating power schedule. The criterion of optimality is the maximization of the rocket final velocity under the constraints of a maximum and minimum allowable reactor power level corresponding to engine throttleable limits and a fixed initial propellant loading that is to be allocated either as useful thrust-producing propellant or as a core afterheat removal coolant yielding no useful thrust. The method of dynamic programming is used to perform the optimization. Numerical results are presented for an example problem that considers vertical, drag-free liftoff from a stationary earth with a uniform gravitational field. Means to relax all of these restrictions, along with other important extensions, are discussed. The effect of varying the problem parameters also is indicated, and implications thereof are pointed out. (auth)

WASTE DISPOSAL AND PROCESSING

24732 (CR-IO-1144) WASTE EFFLUENT EVAPORATORS. N. F. Murray (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1963. 21p. (AECL-1740)

Five evaporator installations that are or have been operated are described. Information on operating experiences, de-entrainment efficiencies, and causes of equipment failure is included for each evaporator. The design of a new low level activity evaporator is also given. (auth)

24733 (DPSPU-63-30-2) LAND BURIAL OF SOLID RADIOACTIVE WASTE DURING A TEN-YEAR PERIOD. J. W. Fenimore (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). May 1963. Contract AT (07-2)-1. 16p.

Since the initial land burial of solid radioactive waste in 1953 at the Savannah River Plant, 577,000 curies of fission products and induced radioactivity have been buried. Routine surveillance of 13 test and observation wells indicated no migration of radioactive material. Geologic and hydrologic studies, radioassays of soil samples, and measurements of ground water velocity using tritium as a tracer indicate little possibility of introducing this buried radioactivity into public zones. Maximum movement detected by radioassay of soil was 2 ft, with one exception. (auth)

24734 (HW-SA-2968) TREATMENT OF A RADIOACTIVE CONDENSATE WASTE. J. M. Skarpelos (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 15, 1963. Contract AT(45-1)-1350. 17p.

The over-all process visualized for treating a waste such as Purex Tank Farm condensate is illustrated. The waste containing ammonia and organics along with a number of radioisotopes is fed to a steam stripper tower. The overhead vapors, representing about 5% of the waste, contain most of the ammonia and organics. Some radioiodine and radioruthenium are also present. After condensing and decanting to separate the two phases formed, it was found that the organic, which represents about 0.02% of the waste, contains most of the ruthenium and iodine present in the overhead stream. The remainder is an aqueous phase containing most of the ammonia but relatively little radioactivity, and thus it can be disposed to the environment without further treatment. The bulk of the waste leaves the stripping tower and is cooled before passing through a precoat type filter using finely divided (200 × 300 mesh) cesium selective adsorbent such as clinoptilolite as the filter aid. This step of the process removes particulate matter and radiocesium from the liquid. The adsorbent cake is discharged for burial whenever its capacity for cesium is utilized, or whenever the pressure drop across the filter reaches a predetermined point. The filtered waste is then passed through a strong base anion bed which removes an appreciable amount of the ruthenium along with nitrate and nitrite ions. Periodically this bed is regenerated with caustic soda. The regenerant solution is discharged to underground storage. Since alkali in excess of the stoichiometric amount must be used, the regenerant solution could be used for neutralizing high-level acid waste, if desirable. The waste leaving the anion bed is acidified to a pH of 4 before entering the cation bed which removes strontium, cerium, zirconium and other radioisotopes in the cationic form. Having an extremely high capacity for these radioisotopes, the cation resin can economically be discharged for burial. The effluent leaving the cation bed is sufficiently low in radioactivity that it can be safely discharged to the environment. If the residual acid needs to be neutralized, the effluent can be combined with the aqueous overhead stream containing ammonia. (auth)

24735 (ORNL-3349(Pt.II)) LOW-RADIOACTIVITY-LEVEL WASTE TREATMENT. PART II. PILOT PLANT DEMONSTRATION OF THE REMOVAL OF ACTIVITY FROM LOW-LEVEL PROCESS WASTES BY A SCAVENGING-PRECIPITATION ION-EXCHANGE PROCESS. R. E. Brooksbank, F. N. Browder, R. R. Holcomb, and W. R. Whitson (Oak Ridge National Lab., Tenn.). May 27, 1963. Contract W-7405-eng-26. 70p.

The results of 16 pilot-plant demonstration runs on the removal of activity from low-activity process wastes by the scavenging-precipitation ion-exchange process are presented. During an eight month period the runs, ranging from 71 to 146 hr of continuous operation and processing 43,000 to 88,000 gal of ORNL process waste water per run, treated 1.3 million gallons of waste and yielded effluents containing Sr^{90} and Cs^{137} in amounts less than 3% of the maximum permissible concentrations in water (MPC_w) for continuous occupational exposure to these radioisotopes. A standard operating capacity of 2,000 resin-bed volumes was used for the CS-100 carboxylic-phenolic resin column based on its capacity for cesium. At 2,000 bed volumes, the decontamination factors for strontium varied from 2,900 to 12,000 (about 99.99% Sr removal) and for cesium from 246 to 3,444 (99.6 to 99.9% Cs removal). The decontamination factor for strontium decreased to 20 (95% removal) and that for cesium to 6 (82% removal) at 3,118 bed volumes. The presence of hexametaphosphate in the waste feed had a deleterious effect on the process, resulting in premature fission product breakthrough from the ion-exchange column. Consequently it is recommended that phosphate be excluded from the wastes. Should this approach be undesirable or impractical, sodium carbonate can be used as a process additive to increase resin bed capacity. Several runs indicated that sodium carbonate addition would assure the complete removal of Sr^{90} in wastes containing less than 2 ppm of PO_4^{3-} but would limit Cs^{137} decontamination. The results of the Pilot Plant and Laboratory work indicate that the process has universal application and will yield an effluent that will not require dilution before ultimate disposal. Process cost studies for a 750,000 gal/day plant indicate a capital cost of $400,000 and a total operating cost of 71.6 cents per 1000 gal. This cost includes chemicals, utilities, labor, maintenance, equipment and building amortization, sludge burial, and evaporation, neutralization, and storage of the resin regenerant in steel tanks. The use of sodium carbonate as a process additive would add 11 cents per 1000 gal to the processing cost. (auth)

24736 THE TREATMENT OF RADIOACTIVE EFFLUENTS BY EVAPORATION. M. Tamisé. Energie Nucl., 5: 85-97(Mar.-Apr. 1963). (In French)

In order to design an efficient effluent evaporator, it is first necessary to know the nature of the solutions to be treated, the origins of which are diverse and the composition variable. The quantity to be treated, probable content in solids and disolved gases, and activity must be considered. In the apparatus design, the difficulties essentially come from the nature of the solutions, which

are foamy and incrusting. The apparatus used in solving the problem by the Kestner Establishments is described. Rules to be followed in the building of the apparatus are given. (auth)

24737 DISPERSION IN THE IRISH SEA OF THE RADIOACTIVE LIQUID EFFLUENT FROM WINDSCALE WORKS OF THE U.K. ATOMIC ENERGY AUTHORITY. J. Mauchline and W. L. Templeton (United Kingdom Atomic Energy Authority, Windscale, Cumb, Eng.). Nature, 198: 623-6(May 18, 1963).

Since 1952, effluent from Windscale has been discharged through a pipeline into the Irish Sea. The hydrography of the Sea area and its background radioactivity are described. Monitoring data collected in 1959 are presented for the beta activities of the sea bottom near Sellafield and in surface water, surface plankton, and bottom invertebrates in various parts of the Sea. The maximum permissible concentrations for beta activity in the sea bottom material, fish, and seaweed are rarely exceeded even for short periods of time. (D.L.C.)

24738 DISPOSAL OF RADIOACTIVE WASTES INTO FRESH WATER. Safety Series No. 10. (International Atomic Energy Agency, Vienna). Mar. 1963. 102p. STI/PUB/44. $1.50; Sch 31.50; 9s. stg; NF 6; DM 4.80. (IAEA)

A discussion and review of findings on the disposal of radioactive wastes into fresh water is presented. Topics discussed include: fate of radioactive wastes in fresh water; radiation exposure from the disposal of radioactive wastes into fresh water; waste-disposal site considerations; legal, administrative, and organizational principles of radioactive-waste pollution control; radioactive pollution control of international fresh water; radioactive wastes sources, amounts, and management practices; main transfer mechanisms of released waste; and radiation dose calculations. (P.C.H.)

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

Æ	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

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166	17-24096	19p. of Bull. Soc. Belge Phys., Ser. III, No. 3 (1962)
BM-RI–	**(Misc.)**	
6242*	17-23430	Free(Bureau of Mines)
BMI–	**(Misc.)**	
1614(Del.)	17-22966	Dep.; $2.00(OTS)
1619(Del.)	17-23864	Dep.; $2.00(OTS)
1627	17-24004	Dep.; $1.00(OTS)
1628	17-24005	Dep.; $0.50(OTS)
BMI-X–		
10038	17-24614	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10039	17-23946	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10040	17-23890	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10041	17-23291	Dep.(mc); $1.60(fs), $0.80(mf) OTS
BNL–		
790	17-23587	Dep.; $1.75(OTS)
6187	17-24615	Dep.(mc); $2.60(fs), $0.92(mf) OTS
6198	17-24006	Dep.(mc); $2.60(fs), $1.07(mf) OTS
6208	17-23032	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6235	17-23594	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6313	17-24007	Dep.(mc); $2.60(fs), $1.01(mf) OTS
6324	17-24262	Dep.(mc); $2.60(fs), $0.83(mf) OTS
6330	17-24616	Dep.(mc); $2.60(fs), $0.89(mf) OTS
6499	17-24471	Nucl. Phys. 42: 676-92(1963)
6544-R	17-23407	Nature, 198: 578-9(1963)
6782	17-23005	Proc. Soc. Exptl. Biol. Med. 112: 1058-62(1963)
6929	17-23076	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6934	17-24263	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6974	17-24515	Dep.(mc); $2.60(fs), $0.98(mf) OTS
BNL-C–		
37	17-23587	See BNL-790
BRL–	**(Misc.)**	
1189*	17-24367	
1190*	17-24599	$16.50(OTS)
CEA-tr–	**(French)**	
A-1285	17-23804	Dep.(mc); $1.60(fs), $0.80(mf) JCL
A-1293	17-23805	Dep.(mc); $1.60(fs), $0.80(mf) JCL
X-499	17-23559	Dep.(mc); $3.60(fs), $1.13(mf) JCL
X-506	17-23388	Dep.(mc); $1.60(fs), $0.80(mf) JCL
CEND–	**(Misc.)**	
178	17-23897	Dep.(mc); $7.60(fs), $2.33(mf) OTS
179	17-23898	Dep.(mc); $3.60(fs), $1.13(mf) OTS
CERN–	**(European Organization for Nuclear Research)**	
63-2	17-24516	Dep.(mc)
63-5	17-23595	Dep.(mc)
CF–	**(Oak Ridge National Laboratory)**	
60-11-90	17-24682	Superseded by ORNL-TM-546
CNLM–		
1192	17-24617	Dep.(mc); $3.60(fs), $1.28(mf) OTS
CR-IO–	**(Canadian)**	
1144	17-24732	Dep.; $0.50(AECL)
CRL–	**(Canadian)**	
41(2nd Ed.)	17-24197	Dep.(mc); $2.00(AECL)
CRRD–	**(Canadian)**	
1109	17-23738	Dep.; $0.50(AECL)
CRT–	**(Canadian)**	
1148	17-23842	Dep.; $1.50(AECL)
CUA-NE–		
26	17-23475	Dep.(mc); $1.60(fs), $0.80(mf) OTS
D–	**(Misc.)**	
1-82-0241*	17-23497	$8.10(OTS)
DASA–	**(Misc.)**	
1325*	17-22977	
DCAS-TDR–	**(Non-AEC)**	
62-191	17-24230	$1.10(OTS)
DESY-A–	**(German)**	
2.97	17-24517	Dep.(mc)
2.98	17-24518	Dep.(mc)
DLCS–		
5000363	17-24675	Dep.(mc); $4.60(fs), $1.55(mf) OTS
DPSPU–		
63-30-1	17-23544	Dep.(mc); $1.10(fs), $0.80(mf) OTS
63-30-2	17-24733	Dep.(mc); $1.60(fs), $0.80(mf) OTS
63-30-3	17-23033	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DRCL–	**(Canadian)**	
398	17-23618	Can. J. Phys. 41: 793-811(1963)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EACRP-U–	**(Swiss)**	
9	17-24618	See EUR-238.e
10	17-24619	Dep.(mc)
12	17-24620	Dep.(mc)
EC.S–	**(French)**	
86	17-24259	See NP-12249
EFINS–	**(Misc.)**	
62-63	17-24319	Nuovo Cimento (10) 28: 263-9(1963)

Report No.	Abstract No.	Availability
EOS–	**(Non-AEC)**	
2080-ML-3	17-24046	See NP-12791
ER–	**(Misc.)**	
5038*	17-24726	See ASD-TDR-62-877
5324*	17-24045	See NP-12790
EUR–	**(European Atomic Energy Community)**	
238.e	17-24618	Dep.(mc)
239.e	17-24619	See EACRP-U-10
281.e	17-24625	Dep.(mc)
EURAEC–		
402	17-23879	Dep.(mc); $4.60(fs), $1.67(mf) OTS
511	17-23928	Dep.(mc); $1.60(fs), $0.80(mf) OTS
512	17-24644	Dep.(mc); $9.10(fs), $3.47(mf) OTS
521	17-23972	Dep.(mc); $3.60(fs), $1.25(mf) OTS
529	17-23865	See GEAP-4139
530	17-24014	Dep.(mc); $4.60(fs), $1.70(mf) OTS
534	17-23880	Dep.(mc); $1.60(fs), $0.80(mf) OTS
540	17-24622	Dep.(mc); $6.60(fs), $2.09(mf) OTS
549	17-24015	Dep.(mc); $2.60(fs), $0.98(mf) OTS
565	17-24645	Dep.(mc); $2.60(fs), $1.10(mf) OTS
593	17-23929	Dep.(mc); $1.60(fs), $0.80(mf) OTS
621	17-24614	See BMI-X-10038
624	17-23457	See ACNP-63013
625	17-23946	See BMI-X-10039
626	17-23890	See BMI-X-10040
628	17-24605	See ACNP-63012
651	17-23291	See BMI-X-10041
652	17-23496	Dep.(mc); $2.60(fs), $0.98(mf) OTS
653	17-23889	See ARF-B198-39
690	17-23897	See CEND-178
691	17-24386	See BAW-1270
692	17-23898	See CEND-179
F–	**(Misc.)**	
A2199	17-24689	See TID-18582
FTD-TT–	**(Non-AEC)**	
62-666	17-24065	OTS
GA–	**(Misc.)**	
2318	17-24623	Dep.; $2.25(OTS)
2568	17-24676	Dep.(mc); $10.50(fs), $4.31(mf) OTS
3448	17-24008	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3469	17-24368	Dep.(mc); $3.60(fs), $1.13(mf) OTS
3542	17-24369	Dep.; $3.00(OTS)
3562(Rev.)*	17-24035	$2.60(OTS)
3585	17-23947	Dep.; $1.25(OTS)
GA-Phys.–	**(Non-AEC)**	
62-2	17-24557	See AD-286404
GAT-T–		
1085	17-23251	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GCA-TR–	**(Misc.)**	
63-3-G	17-23498	Dep.(mc); $8.10(fs), $2.87(mf) OTS
GD-C–	**(Non-AEC)**	
63-068	17-23460	$3.60(OTS)
GEAP–	**(Misc.)**	
3474	17-24677	Dep.(mc); $8.10(fs), $2.66(mf) OTS
3923	17-24624	Dep.(mc); $3.60(fs), $1.37(mf) OTS
3981	17-24625	Dep.(mc); $9.60(fs), $3.71(mf) OTS
4139	17-23865	Dep.; $1.50(OTS)
4213	17-24678	Dep.(mc); $10.10(fs), $3.98(mf) OTS
GEMP–		
22A	17-24009	Dep.; $0.50(OTS)
76	17-24626	Dep.; $1.25(OTS)
200	17-24036	Dep.; $1.25(OTS)
HASL–		
133	17-23739	Dep.; $0.75(OTS)
HW–		
63328	17-24627	Dep.(mc); $1.10(fs), $0.80(mf) OTS
64888	17-23545	Dep.(mc); $1.60(fs), $0.80(mf) OTS
74304	17-23899	Dep.; $2.50(OTS)
76128	17-24037	Dep.; $1.75(OTS)
76300	17-23866	Dep.; $2.50(OTS)
77279	17-24370	Dep.(mc); $1.60(fs), $0.80(mf) OTS
77296	17-24387	Dep.; $0.50(OTS)
77690	17-23546	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-SA–		
2267	17-23020	p.401-14 of "Use of Radioisotopes in Animal Biology and the Medical Sciences, Vol. 1." New York, Academic Press, 1962
2822	17-23060	Proc. Soc. Exptl. Biol. Med. 112: 186-8(1963)
2885	17-23055	Nature, 198: 703-4(1963)
2946	17-24628	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2968	17-24734	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2981	17-24629	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2997	17-24713	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3022	17-23547	Dep.(mc); $1.10(fs), $0.80(mf) OTS
IA–	**(Non-AEC)**	
802	17-23740	
806	17-24371	Dep.(mc)
IDO–		
11004	17-24630	Dep.(mc); $10.10(fs), $3.95(mf) OTS
14606	17-23431	Dep.; $0.75(OTS)
16768	17-24714	Dep.; $1.00(OTS)
16833(Rev.1)	17-24631	Dep.; $2.75(OTS)
16853	17-24632	Dep.; $1.50(OTS)
16857	17-22967	Dep.; $1.75(OTS)
IFA-A–	**(Rumanian)**	
23	17-24372	Dep.(mc)
28	17-24519	Dep.(mc)
IFA-CO–	**(Rumanian)**	
21	17-23380	Dep.(mc)
IFA-IS–	**(Rumanian)**	
21	17-24010	Dep.(mc)
IG-Report–	**(British)**	
142	17-24258	Dep.(mc); $0.63(BIS); 4s. 6d. (HMSO)
IS–		
419	17-23476	Dep.; $2.50(OTS)
518	17-23292	Dep.(mc); $1.60(fs), $0.80(mf) OTS
519	17-24388	Dep.(mc); $2.60(fs), $1.10(mf) OTS
521	17-23948	Dep.(mc); $1.60(fs), $0.80(mf) OTS
533	17-23293	Dep.(mc); $2.60(fs), $1.07(mf) OTS
534	17-23294	Dep.(mc); $2.60(fs), $0.83(mf) OTS
535	17-23295	Dep.(mc); $2.60(fs), $0.92(mf) OTS
536	17-23949	Dep.(mc); $2.60(fs), $0.98(mf) OTS
538	17-23950	Dep.(mc); $2.60(fs), $0.95(mf) OTS
543	17-23296	Dep.(mc); $1.60(fs), $0.80(mf) OTS
544	17-23297	Dep.(mc); $3.60(fs), $1.28(mf) OTS
550	17-23252	Dep.(mc); $1.60(fs), $0.80(mf) OTS
554	17-23985	J. Appl. Phys. 34: 768-70(1963)
561	17-23253	Dep.(mc); $1.60(fs), $0.80(mf) OTS
591	17-23239	J. Am. Chem. Soc. 85: 1002-3(1963)

Report No.	Abstract No.	Availability
645	17-23596	Dep.(mc); $1.60(fs), $0.80(mf) OTS
JAERI–	**(Japanese)**	
1047	17-23432	Dep.(mc)
7026	17-22968	Dep.(mc)
JINR–	**(Russian)**	
E-1204	17-24038	Dep.(mc)
P-1209	17-24389	Dep.(mc)
P-1216	17-24390	Dep.(mc)
P-1219	17-24264	Dep.(mc)
P-1228	17-23843	Dep.(mc)
P-1238	17-24391	Dep.(mc)
JPL-TR–	**(Non-AEC)**	
32-360	17-23951	
JPRS–	**(Non-AEC)**	
19316	17-24066	$6.00(OTS)
K–		
1444	17-23597	Dep.; $0.50(OTS)
KR–	**(Norwegian)**	
38	17-23900	Dep.(mc)
KY–		
400	17-23548	Dep.(mc); $1.10(fs), $0.80(mf) OTS
LA–		
1349(Del.)	17-23867	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2853	17-23598	Dep.; $2.75(OTS)
2858	17-24633	Dep.; $2.00(OTS)
2886	17-24039	Dep.; $1.00(OTS)
LADC–		
5331	17-23599	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5384	17-23952	Dep.(mc); $3.60(fs), $1.13(mf) OTS
5460	17-23844	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5464	17-23355	J. Phys. Chem. 67: 793-6(1963)
5465	17-23845	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5466	17-23953	Dep.(mc); $4.60(fs), $1.43(mf) OTS
5467	17-23077	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5468	17-23991	J. Phys. Chem. 67: 796-801(1963)
5474	17-24520	Dep.(mc); $3.60(fs), $1.13(mf) OTS
5476	17-23600	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5478	17-23954	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5481	17-23034	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5484	17-23846	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5488	17-23298	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5490	17-24727	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5497	17-24463	Nucl. Phys. 42: 608-14(1963)
5707	17-24337	Phys. Letters 4: 255-6(1963)
5719	17-23901	Dep.(mc); $2.60(fs), $0.92(mf) OTS
LAL–	**(French)**	
1048	17-24521	Dep.(mc)
LAMS–		
1739	17-24392	Dep.(mc); $11.50(fs), $4.88(mf) OTS
LAS-SR–		
161-60	17-23588	Dep.(mc); $1.60(fs), $0.80(mf) OTS
LNF–	**(Italian)**	
62/108	17-24265	Dep.(mc)
62/111	17-23601	Dep.(mc)
63/1	17-23602	Dep.(mc)
63/2	17-23603	Dep.(mc)
63/3	17-23604	Dep.(mc)
63/4	17-23605	Dep.(mc)
63/5	17-24040	Dep.(mc)
63/15	17-24393	Dep.(mc)
63/22	17-24266	Dep.(mc)
MATT–		
144	17-24583	J. Math. Phys. (N. Y.), 4: 533-43(1963)
187	17-23606	Dep.(mc); $1.10(fs), $0.80(mf) OTS
MF–	**(Misc.)**	
35	17-24051	See NYO-10428
MITNE–	**(Misc.)**	
27*	17-24679	
31	17-23433	Dep.(mc); $3.60(fs), $1.13(mf) OTS
ML–	**(Misc.)**	
918*	17-23607	$5.60(OTS)
1024	17-24559	Dep.(mc); $2.60(fs), $0.95(mf) OTS
MLM–		
987	17-23299	Dep.; $0.75(OTS)
MND–	**(Misc.)**	
2866-1*	17-24041	$1.10(OTS)
MND-P–		
2953	17-24728	Dep.(mc); $8.10(fs), $2.78(mf) OTS
MURA–	**(Misc.)**	
666	17-24522	Dep.; $0.50(OTS)
667	17-24523	Dep.; $0.50(OTS)
NAA-SR–		
5340	17-24680	Dep.(mc); $3.60(fs), $1.13(mf) OTS
5947	17-24681	Dep.; $1.00(OTS)
6246	17-23902	Dep.; $0.75(OTS)
7755	17-23891	Dep.; $0.75(OTS)
8085	17-23300	Dep.; $0.50(OTS)
NAA-SR-Memo–		
4757	17-24634	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7418	17-23477	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8181	17-24600	Dep.(mc); $1.10(fs), $0.80(mf) OTS
8274	17-24394	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NASA-TN–	**(Misc.)**	
D-1654*	17-24042	
D-1657*	17-24043	$1.25(OTS)
D-1665*	17-24729	
D-1791*	17-23301	$1.75(OTS)
NAVWEPS–	**(Non-AEC)**	
7227	17-23302	
NIRL-R–	**(British)**	
23	17-24524	Dep.(mc)
NLCO–		
862	17-23868	Dep.(mc); $1.60(fs), $0.80(mf) OTS
869	17-23035	Dep.(mc); $2.60(fs), $0.92(mf) OTS
870	17-23425	Dep.; $2.00(OTS)
876	17-24011	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NMI–	**(Misc.)**	
2802	17-23955	Dep.(mc); $6.60(fs), $2.27(mf) OTS
2803	17-23903	Dep.(mc); $7.60(fs), $2.42(mf) OTS
2804	17-23904	Dep.(mc); $9.10(fs), $3.44(mf) OTS
2806	17-23956	Dep.(mc); $4.60(fs), $1.43(mf) OTS
7247	17-23957	Dep.(mc); $2.60(fs), $0.98(mf) OTS
9700.9*	17-23905	
NP–	**(AEC File No. for Non-AEC Reports)**	

Report No.	Abstract No.	Availability
12249	17-24259	Dep.(mc)
12672	17-23303	Dep.(mc)
12674	17-23078	Dep.(mc)
12675	17-23741	Dep.(mc)
12754	17-24715	Dep.(mc); $9.60(fs), $3.65(mf) OTS
12760	17-23079	
12763	17-24044	
12770	17-23958	Dep.(mc)
12773	17-23499	
12789	17-23869	
12790	17-24045	
12791	17-24046	
12792	17-24047	
12793	17-23959	
12794	17-24716	Dep.(mc); $15.00(fs), $6.83(mf) OTS
12795	17-24048	OTS
12796	17-23960	
12797	17-24560	
NP-tr-	**(AEC File No. for Non-AEC Translations)**	
1011	17-23881	Dep.(mc); $3.60(fs), $1.25(mf) JCL
NRC-	**(Canadian)**	
7380	17-24099	Can. J. Phys. 41: 827-8(1963)
NRL-Memo-	**(Misc.)**	
1404*	17-24049	
NYO-		
9290	17-24267	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9290A	17-24268	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10151	17-23461	Dep.(mc); $2.60(fs), $0.83(mf) OTS
10241	17-24269	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10261	17-23742	Dep.(mc); $4.60(fs), $1.64(mf) OTS
10263	17-24270	Dep.(mc); $3.60(fs), $1.34(mf) OTS
10396	17-23498	See GCA-TR-63-3-G
10425	17-24050	Dep.(mc); $8.10(fs), $2.87(mf) OTS
10428	17-24051	Dep.(mc); $2.60(fs), $0.95(mf) OTS
10445	17-24021	J. Appl. Phys. 34: 611-18(1963)
10479	17-23382	See RRL-109
10588	17-23463	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORNL-		
332(3rd. Ed.)	17-23549	Dep.; $2.50(OTS)
3349(Pt.II)	17-24735	Dep.; $1.75(OTS)
3404	17-23434	Dep.; $2.00(OTS)
3422	17-24052	Dep.; $1.50(OTS)
3430	17-23847	Dep.; $3.60(fs), $1.22(mf) OTS
3432	17-24053	Dep.; $2.25(OTS)
3433	17-24395	Dep.; $2.25(OTS)
3443	17-24012	Dep.; $2.25(OTS)
ORNL-TM-		
542	17-23961	Dep.(mc); $3.60(fs), $1.31(mf) OTS
546	17-24682	Dep.(mc); $8.60(fs), $3.05(mf) OTS
547	17-24683	Dep.(mc); $4.60(fs), $1.64(mf) OTS
553	17-23848	Dep.(mc); $1.60(fs), $0.80(mf) OTS
555	17-23550	Dep.(mc); $1.60(fs), $0.80(mf) OTS
556	17-24396	Dep.(mc); $3.60(fs), $1.22(mf) OTS
577	17-24717	Dep.(mc); $1.10(fs), $0.80(mf) OTS
580	17-23435	Dep.(mc); $2.60(fs), $1.07(mf) OTS
PA-TR-	**(Non-AEC)**	
3053	17-23234	
3072	17-23381	
PATENTS	**(Czechoslovakia)**	
96,354	17-23733	
PATENTS	**(German)**	
1,066,554	17-23805	
PATENTS	**(U. S.)**	
3,089,032	17-23800	
3,089,235	17-23934	
3,089,754	17-23888	
3,089,756	17-23453	
3,089,758	17-23454	
3,089,759	17-23455	
3,089,785	17-23935	
3,089,831	17-24597	
3,089,832	17-23424	
3,089,834	17-24710	
3,089,835	17-24665	
3,089,836	17-24711	
3,089,837	17-24666	
3,089,885	17-23429	
3,089,954	17-23734	
3,089,955	17-23801	
3,089,956	17-23735	
3,089,958	17-23802	
3,089,983	17-24598	
PATENTS	**(U.S.S.R.)**	
143,480	17-23803	
PG-Report-	**(British)**	
220	17-23254	Dep.; $0.42(BIS); 3s. (HMSO)
239	17-23255	Dep.; $0.49(BIS); 3s. 6d. (HMSO)
437	17-23256	Dep.; $0.17(BIS); 1s. 3d. (HMSO)
438	17-23257	Dep.
PIBMRI-	**(Non-AEC)**	
1112-63	17-24561	$1.50(OTS)
PNE-	**(Misc.)**	
229P*	17-23551	Dep.; $1.25(OTS)
PRDC-TR-		
64	17-24684	Dep.(mc); $1.60(fs), $0.80(mf) OTS
66	17-24685	Dep.(mc); $1.60(fs), $0.80(mf) OTS
Q-	**(Misc.)**	
B1933-5*	17-23937	See AD-403757
R-	**(Misc.)**	
100*	17-23958	See NP-12770
62SD47*	17-24562	$1.60(OTS)
RADC-TDR-	**(Misc.)**	
62-486*	17-23608	$2.60(OTS)
63-43*	17-23906	
RFP-		
175	17-23552	Dep.(mc); $2.60(fs), $0.86(mf) OTS
RISO-	**(Danish)**	
57	17-23743	Dep.(mc); Jul. Gjellerup, 87, Sölvgade, Copenhagen K, Denmark
RM-	**(Misc.)**	
3189PR*	17-23553	$4.60(OTS)
RRL-		
109	17-23382	Dep.(mc); $1.60(fs), $0.80(mf) OTS
112	17-23383	Dep.(mc); $12.50(fs), $5.45(mf) OTS
RT-CHI-	**(Italian)**	
(63)-3	17-23436	Dep.(mc)
SB-	**(Non-AEC)**	
472(Suppl.1)	17-23860	$0.10(OTS)
511	17-23209	$0.10(OTS)

Report No.	Abstract No.	Availability
SC–	**(Misc.)**	
4777(RR)	17-23478	Dep.; $1.50(OTS)
4784(RR)	17-23258	Dep.; $0.50(OTS)
SCDC–		
2858	17-24271	See TID-16793
2886	17-23962	See TID-16906
2907	17-24013	See TID-18630
3101	17-23458	See ARF-3216-4
3102	17-23459	See ARF-3216-5
SCPRI(A)–	**(French)**	
75	17-23554	Dep.(mc)
SCPRI(RM)–	**(French)**	
III-63	17-23555	Dep.(mc)
SCR–		
245A	17-24397	Dep.; $4.00(OTS)
593	17-23384	Dep.(mc); $4.60(fs), $1.58(mf) OTS
607	17-23849	Dep.; $5.00(OTS)
623	17-24054	Dep.(mc); $5.60(fs), $1.85(mf) OTS
SCTM–		
76-63(24)	17-23609	Dep.(mc); $3.60(fs), $1.37(mf) OTS
365-61(73)	17-23610	Dep.(mc); $4.60(fs), $1.43(mf) OTS
SL–	**(Misc.)**	
1974-4	17-24686	Dep.(mc); $3.60(fs), $1.22(mf) OTS
SRO–		
82	17-24687	Dep.(mc); $1.60(fs), $0.80(mf) OTS
STI-DOC–	**(International Atomic Energy Agency)**	
15	17-23072	$1.00(IAEA)
STI-PUB–	**(International Atomic Energy Agency)**	
44	17-24738	$1.50(IAEA)
T–	**(Misc.)**	
373R*	17-24232	
TDR–	**(Non-AEC)**	
69(2260-20)TN-1	17-24230	See DCAS-TDR-62-191
TID–		
7620(Pt.I)	17-23907	Dep.; $3.50(OTS)
7656	17-22969	Dep.(mc); $10.10(fs), $4.10(mf) OTS
13798	17-23611	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15095	17-23231	Radiation Res. 18: 177-85(1963)
15831	17-23744	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16087	17-23483	A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 9: 306-9(1963)
16133	17-23153	Radiation Res. 18: 58-64(1963)
16176	17-23426	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16181	17-23556	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16185	17-23036	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16186(Rev.)	17-23745	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16188	17-23612	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16262	17-24398	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16263	17-23304	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16300	17-24399	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16301	17-24400	Dep.(mc); $2.60(fs), $0.92(mf) OTS
16793	17-24271	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16814	17-23213	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16858	17-23892	Dep.(mc); $5.60(fs), $1.82(mf) OTS
16871	17-23870	Dep.(mc); $2.60(fs), $1.04(mf) OTS
16886	17-22992	J. Agr. Food Chem. 11: 103-7(1963)
16894	17-23385	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16897	17-23871	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16898	17-23479	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16906	17-23962	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16908	17-24272	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16914	17-23305	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16928	17-23067	Radiation Res. 18: 620-32(1963)
16930	17-23437	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16939	17-24401	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16981	17-23214	Dep.(mc); $2.60(fs), $0.98(mf) OTS
16982	17-23215	Dep.(mc); $3.60(fs), $1.37(mf) OTS
17150	17-23349	J. Inorg. Nucl. Chem., 25: 349-51(1963)
17154	17-24325	Nuovo Cimento (10) 28: 364-7(1963)
17792	17-23480	Dep.; $2.50(OTS)
17962	17-24411	Ann. Phys. (N. Y.) 22: 54-67(1963)
17991	17-23328	J. Am. Chem. Soc. 85: 1541(1963)
18031	17-23091	Dep.(mc); $2.60(fs), $0.86(mf) OTS
18114	17-24338	Phys. Letters, 4: 265-7(1963)
18201	17-23109	Biophys. J., 3: 189-97(1963)
18552	17-23746	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18568	17-24688	Dep.(mc); $6.60(fs), $2.27(mf) OTS
18574	17-23613	Dep.(mc); $2.60(fs), $0.98(mf) OTS
18582	17-24689	Dep.(mc); $21.00(fs), $9.74(mf) OTS
18604	17-23438	Dep.(mc); $8.60(fs), $3.17(mf) OTS
18608	17-23557	Dep.(mc); $8.10(fs), $2.72(mf) OTS
18610	17-24662	$5.00 per yr. (Euratom)
18611	17-24663	$5.00 per yr. (Euratom)
18612	17-23963	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18619	17-23964	Dep.(mc); $6.60(fs), $2.06(mf) OTS
18620	17-23850	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18622	17-23037	Dep.(mc); $9.10(fs), $3.32(mf) OTS
18625	17-23092	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18626	17-23872	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18629	17-23851	Dep.(mc); $4.60(fs), $1.52(mf) OTS
18630	17-24013	Dep.(mc); $6.60(fs), $2.09(mf) OTS
18632	17-23965	Dep.(mc); $2.60(fs), $0.92(mf) OTS
18633	17-24402	Dep.(mc); $11.00(fs), $4.55(mf) OTS
18635	17-23306	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18636	17-24525	Free, DTI Extension
18637	17-23966	Dep.(mc); $5.60(fs), $1.94(mf) OTS
18638	17-23967	Dep.(mc); $3.60(fs), $1.31(mf) OTS
18644	17-24055	Dep.(mc); $1.10(fs), $0.80(mf) OTS
18647	17-23747	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18648	17-23558	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18649	17-23038	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18658	17-24056	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18669	17-23968	Dep.(mc); $4.60(fs), $1.52(mf) OTS
18671	17-24057	Dep.(mc); $3.60(fs), $1.31(mf) OTS
TRG-Report–	**(Non-AEC)**	
198(Suppl.1)	17-23852	Dep.; $0.25(BIS); 1s. 9d. (HMSO)
515	17-23614	Dep.; $0.42(BIS); 3s. (HMSO)
UAC–		
6431	17-23612	See TID-16188
6443	17-23036	See TID-16185
6462	17-23304	See TID-16263
6465	17-24398	See TID-16262
6599	17-24272	See TID-16908
6645	17-23941	See ANL-FGF-364
6654	17-24401	See TID-16939
6665	17-23385	See TID-16894
6698	17-23479	See TID-16898
6724	17-24325	See TID-17154
6737	17-23349	See TID-17150
UCRL–		
6450(Rev.1)	17-24059	Dep.(mc); $5.60(fs), $1.91(mf) OTS
6635	17-24060	Dep.(mc); $2.60(fs), $1.34(mf) OTS
6693	17-24231	Dep.; $1.00(OTS)
6889	17-23500	Dep.(mc); $8.60(fs), $2.63(mf) OTS
7002	17-24314	Nucl. Phys. 43: 31-44(1963)
7065-T	17-24198	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9845(Rev.)	17-24061	Dep.(mc); $3.60(fs), $1.16(mf) OTS
10326	17-23463	Dep.(mc); $1.60(fs), $0.80(mf) OTS

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10360(Rev.)	17-23386	Dep.(mc); $2.60(fs), $1.10(mf) OTS
10365	17-23969	Dep.(mc); $3.60(fs), $1.16(mf) OTS
10379	17-24563	Dep.(mc); $3.60(fs), $1.16(mf) OTS
10385	17-24537	Nucl. Instr. Methods 22: 87-92(1963)
10399	17-24564	Dep.(mc); $3.60(fs), $1.19(mf) OTS
10402	17-24062	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10414	17-24403	Dep.(mc); $2.60(fs), $1.01(mf) OTS
10433	17-23874	Dep.(mc); $3.60(fs), $1.13(mf) OTS
10445	17-24063	Dep.(mc); $3.60(fs), $1.19(mf) OTS
10456	17-24404	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10464	17-24405	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10559	17-23093	Dep.; $0.50(OTS)
10584(Rev.)	17-24273	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10585	17-24274	Dep.; $2.25(OTS)
10629	17-24275	Dep.; $2.00(OTS)
10654(Abridged)	17-24526	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10677	17-24276	Dep.; $1.00(OTS)
10687	17-23387	Dep.; $2.50(OTS)
10702	17-23307	Dep.; $1.00(OTS)
10703	17-24277	Dep.; $2.25(OTS)
10705	17-24527	Dep.; $0.50(OTS)
10717	17-23308	Dep.; $2.25(OTS)
10740	17-24565	Dep.; $0.75(OTS)
10744	17-23853	Dep.; $1.25(OTS)
10756	17-24528	Dep.(mc); $2.60(fs), $0.89(mf) OTS
UCRL-Trans-		
926(L)	17-24278	Dep.(mc); $2.60(fs), $0.92(mf) JCL
930(L)	17-23973	Dep.(mc); $2.60(fs), $0.98(mf) JCL
UNC-	**(Misc.)**	
5048	17-23873	Dep.; $1.25(OTS)
UR-		
625	17-23094	Dep.; $2.60(fs), $1.01(mf) OTS
USASRDL-TR-	**(Non-AEC)**	
2272	17-23615	$2.60(OTS)
USBM-U-	**(Misc.)**	
929	17-23875	Dep.(mc); $5.60(fs), $1.82(mf) OTS
1031	17-23876	Dep.; $0.75(OTS)
USNRDL-TR-	**(Non-AEC)**	
621	17-23748	$2.60(OTS)
629	17-22978	$1.10(OTS)
634	17-23095	$1.60(OTS)
637	17-23259	Dep.(mc); $2.60(fs), $1.07(mf) OTS
VDIT-	**(Swedish)**	
73	17-23877	Dep.(mc)
74	17-23878	Dep.(mc)
WAL-TR-	**(Non-AEC)**	
766.2/3-3	17-23970	$2.60(OTS)
WAPD-	**(Misc.)**	
230	17-23464	Dep.; $1.25(OTS)
WAPD-BT-		
28	17-24635	Dep.; $2.00(OTS)
WAPD-T-		
1451	17-24637	See WAPD-BT-28(p.21-6)
WAPD-TM-	**(Misc.)**	
333	17-24406	Dep.; $1.75(OTS)
356	17-24601	Dep.; $1.00(OTS)
365	17-23854	Dep.; $2.00(OTS)
WCAP-	**(Misc.)**	
1700	17-24641	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1703	17-23927	Dep.(mc); $3.60(fs), $1.16(mf) OTS
1820	17-24058	Dep.(mc); $4.60(fs), $1.61(mf) OTS
1865	17-24064	Dep.(mc); $3.60(fs), $1.34(mf) OTS
1868	17-23971	Dep.(mc); $3.60(fs), $1.25(mf) OTS
3704	17-23855	Dep.(mc); $6.60(fs), $2.21(mf) OTS
3709	17-24373	Dep.(mc); $3.60(fs), $1.13(mf) OTS
3714	17-24642	Dep.(mc); $7.60(fs), $2.36(mf) OTS
3722(Vol.I)	17-23856	Dep.(mc); $7.60(fs), $2.36(mf) OTS
3722(Vol.II)	17-23857	Dep.(mc); $14.00(fs), $6.26(mf) OTS